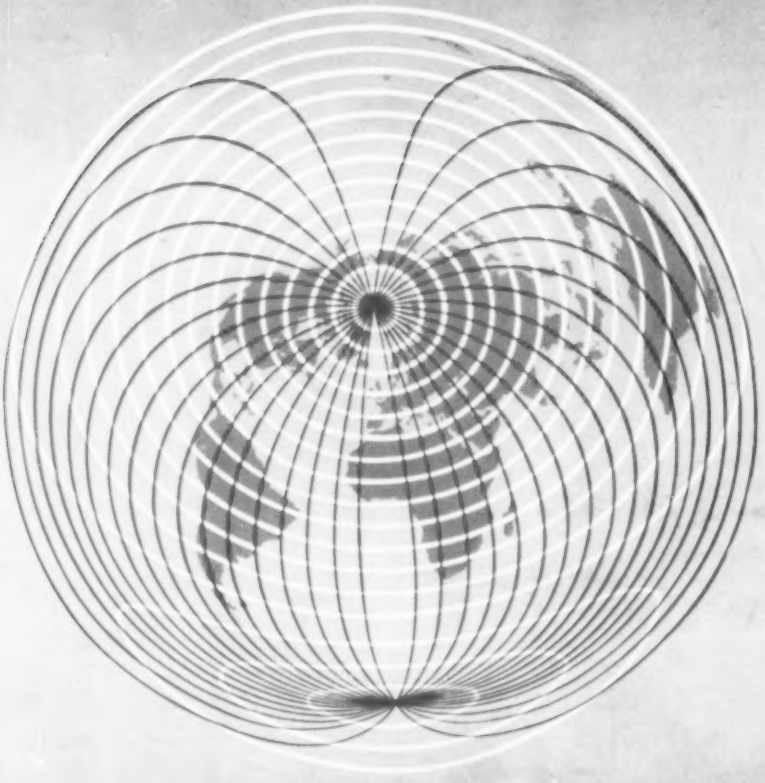
Wireless World

NOVEMBER 1952 · TWO SHILLINGS



RADIO, TELEVISION AND ELECTRONICS

A new low-priced

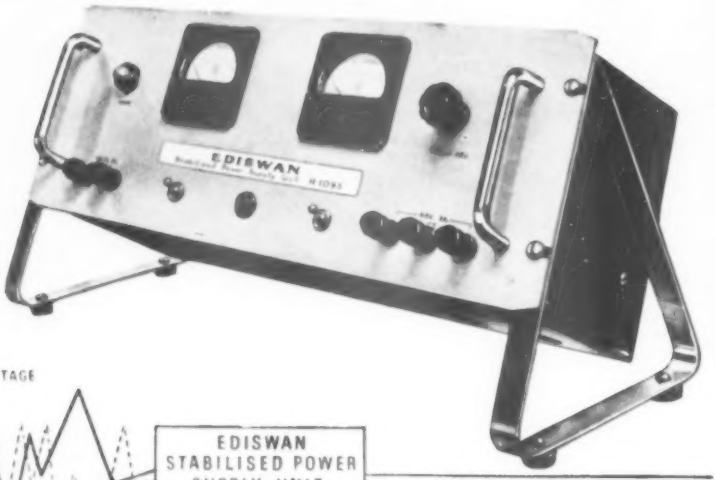
STABILIZED POWER SUPPLY UNIT

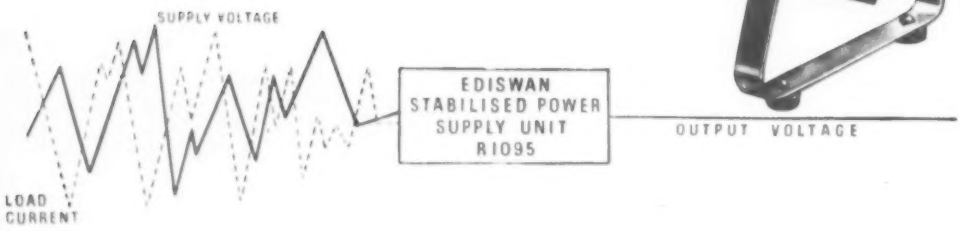
PRICE

Stabilized Power Supply Unit (metered) **£23.2.6**

Stabilized Power Supply Unit (with out meters) **£18.18.6**

Plated Bench Stands **£1.1.0**





Designed and developed as a result of many years experience in the design and use of Stabilised Power Supplies for research and test purposes, the Ediswan Stabilised Power Supply Unit R.1095 is an entirely new, low-priced constant voltage source.

Operating on 200-250 volts, 40-100 cycles A.C. supply it provides an adjustable 120-250 volts D.C. highly stabilized supply at 0-50 mA and a 6.3v C.T. 3 amp. A.C. unstabilized output for heater supply.

The stability is such that with mains change of 10v, output change is less than 0.1v. With load change of 0-50 mA, output change is less than 0.1v.

Output resistance less than 2 ohms. Ripple approximately 2 mV.

The unit can be supplied with or without meters. Provision is made for the addition of meters at a later date.

The unit is designed for standard 19" rack mounting or for bench use. Plated bench stands as illustrated are available if required.

Further details are available on request.

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SP70

AVO

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Signal GENERATOR

An inexpensive yet precision instrument designed especially to meet the exacting needs of the modern service engineer and laboratory technician. With six frequency ranges covering 50 Kc/s. to 80 Mc/s., its accuracy is better than ± 1% of the scale reading.

50 Kc/s.-150 Kc/s.	1.5 Mc/s.-5.5 Mc/s.
150 Kc/s.-500 Kc/s.	5.5 Mc/s.-20 Mc/s.
500 Kc/s.-1.5 Mc/s.	20 Mc/s.-80 Mc/s.

Scale sub-divisions provide more than adequate discrimination for use in television circuits. Note the starred features below, which combine to maintain a minimum signal of less than 1μV up to 20 Mc/s. and less than 3μV between 20 Mc/s. and 80 Mc/s.

★OUTPUT 1
Co-axial socket for attenuated output. Force socket located totally within H.F. compartment.

MAINS TRANSFORMER 2
Marked tagboard for inputs of 100–130 V. and 200–260V., A.C. 50/60 c/s.

★CAST ALUMINIUM H.F. COMPARTMENT and CHASSIS 3
Large number of fixing holes for H.F. compartment cover ensures excellent electrical bonding and good screening.

FUSE 4
Easily accessible when replacement is necessary.

VALVES 5
Standard types run at a rating to ensure long life.

TURRET COIL SWITCHING 6
Standard "AVO" practice.

★ATTENUATOR SYSTEM 7
Employs close tolerance, high stability midget carbon resistors, low reactance rotary potentiometer modified for H.F. operation with carefully designed screening.

Other features include:

ILLUMINATED SPOT RANGE SELECTOR
Gives rapid identification of operational band with intensified lighting round precise frequency. Fine hair line gives close discrimination, particularly on high frequencies.

STOPS
Separate stops prevent turning of dial with respect to condenser.

★MAINS FILTER SYSTEM
This is screened from main electrical assembly.

BUSHING PLATES
provide additional rigidity for rotary controls

SLOW MOTION DRIVE
substantially free from backlash

MAINS MODEL 100—130 V. and 200—260 V. A.C., 50—60c/s. OR BATTERY MODEL..... £38

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SG2

A

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For Low Voltage or Mains

Illustrated are a few of our wide range of new signal or indicator lamps.

A new mains voltage lampholder, Cat. No. S.L.88/N, has been developed for use with the Arcolectric MES neon tube. Among the features of this design are easy lamp replacement, from front or rear of panel, and a built-in resistor.

The low voltage lampholders are designed for use with standard MES bulbs. Features are, easy single-hole fixing and pleasing appearance. Bulbs are accessible from front or back of panel. Insulation of all types will withstand a flash test in excess of 1,500 volts A.C.

Write for Catalogue No 127

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S.L.90

S.L.86

S.L.82

S.L.92

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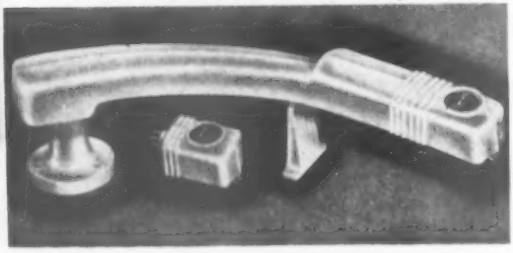
AN EVENT
IN GRAMOPHONE REPRODUCTION



CHANCERY introduce the GP.80 Micro-Cell High Fidelity Pick-up. This new Pick-up specially designed to reproduce the superb music on Long Playing records, will also set a new standard of reproduction on 78 r.p.m. records.

The Interchangeable plug-in heads each balanced and self compensated are fitted with a semi-permanent sapphire styli, 8/9 and 14/16 grams for L.P. and Std., negligible record wear and minimum surface noise.

One of the many features of this fine Pick-up is the simple but effective fully adjustable Stylus pressure mechanism (Pats. applied).

Type GP.80 Pick-up with either Long Playing or Standard Head, **£3 0 8**, inc. tax.

Type GP.80 Pick-up with both Long Playing and Standard Heads, **£4 16 8**, inc. tax.

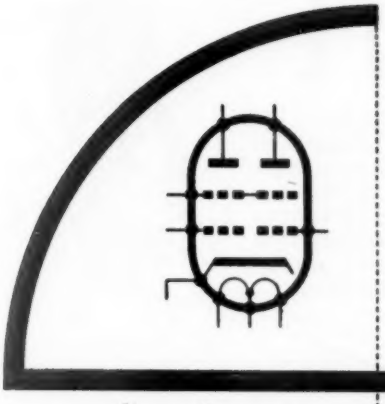
NOTE !—A special 3-pin Head fitted for either Long Playing or Standard is available to plug into a Garrard Record Changer or Decca XMS arm, **£1 16 -**, *inc. tax.*

Chancery INSTRUMENT

YOUR DEALER WILL HAVE FULL DETAILS OF THIS OUTSTANDING PICK UP. IN THE EVENT OF DIFFICULTY PLEASE WRITE TO:—

CHANCERY PRECISION INSTRUMENTS LTD.

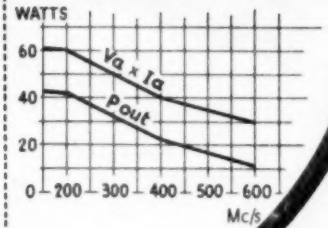
SALES DEPT., 64 GEORGE STREET, BAKER STREET, LONDON, W.1. *Telephone: WELbeck 2535/6/7*



PRINCIPAL CHARACTERISTICS OF THE QQV03-20

	Series	Parallel
HEATER		
V_h	12.6	6.3V
I_h	0.65	1.2A
CAPACITANCES		
Each Section		
$c_{g1\text{-}all}$	6.5 μμF	
$c_{a\text{-}all}$	2.0 μμF	
Two Sections in Push-Pull		
c_{out}	1.3 μμF	
c_{in}	4.0 μμF	
LIMITING VALUES		
As Class "C" push-pull amplifier for C.W. Telegraphy or for F.M.		
V_a max.		600 V
p_a max.		2 x 10 W
V_{g2} max.		250 V
p_{g2} max.		2 x 2 W
V_{g1} max.		-75 V
p_{g1} max.		2 x 0.5 W
I_k max.		2 x 55 mA
f max. (at reduced ratings)		600 Mc/s

BASE B7A



A high performance Double Tetrode for the new U.H.F. waveband allocations

PROVIDING 15 watts output at 500 Mc/s, and with an effective upper frequency limit of 600 Mc/s, this new Mullard double tetrode, the QQV03-20, is an ideal valve for communications equipment designed to operate in the new U.H.F. wave-band allocations.

As a result of new and important design features, this valve has the outstanding advantages of high anode efficiency, excellent power gain, low filament consumption, and small physical dimensions. In addition, being of conventional all glass technique, the QQV03-20 does not require the complex and expensive circuitry that is normally associated with the disc-seal type of U.H.F. valves.

This double tetrode has special advantages in compact communications equipment, where, due to its small size and low filament consumption, it enables maximum savings in space to be made.

Brief technical details of the QQV03-20 are given above. More comprehensive information will be gladly supplied on request.

Mullard

MULLARD LTD., COMMUNICATIONS & INDUSTRIAL VALVE DEPT., CENTURY HOUSE, SHAFTESBURY AVENUE, LONDON, W.C.2

MVT 120

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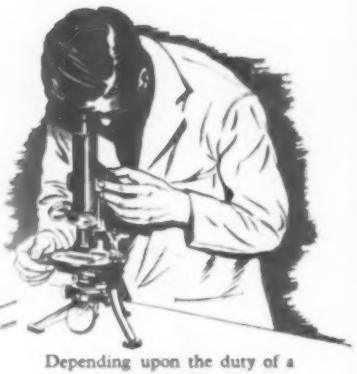
The manufacture of resistors is *not* like "shelling peas". The reverse is true. Specialists alone fully appreciate the diverse problems. A standard Service-type vitreous-enamelled resistor, for example, is completed after twenty separate operations, each of which calls for close control to ensure maximum reliability and stability in the field. The microscope (x 100) is constantly used to examine the standard of these individual operations and is evidence of our insistence that 100% efficiency is maintained throughout production.



Resistors by ERG

(Type Approved for all Service Departments)

Depending upon the duty of a resistor, special protective coatings are available:

VITREOUS · CEMENT
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Full information on the application of ERG Wire Wound Resistors is to be obtained from our London Sales Office: 10 Portman Square, London, W.1. (Welbeck 8114).

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The set, incorporating a 12in. C.R.T. and 10in. Loudspeaker, operates on A.C. Mains 200/250 v., is now available in a beautifully veneered two-tone walnut cabinet 35in. high 20in. wide 20½in. deep. There are two main controls, sound volume and picture brightness, situated on the front of the cabinet and the usual pre-set controls are on the side.

PRICE 63 Gns. Tax Paid

The usual ARMSTRONG GUARANTEE "Purchase money refunded in full if dissatisfied" is in force and a Comprehensive Maintenance Scheme is available to cover replacement C.R.T. and Valves. Installation in the home is free and erection of aerial can be arranged at moderate cost.

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OTHER MODELS IN THE ARMSTRONG RANGE include

MODEL EXP. 125/3 14-valve all-wave Radio ram chassis. A.C. Mains £36.15.-, plus P.T.

MODEL RF.104 10-valve all-wave Radio chassis. A.C. Mains, £34.-.-, plus P.T.

MODEL XP. 73 8-stage all-wave Radio chassis. A.C. Mains £17.15.-, Plus P.T.

The Armstrong Console Model T.V. 15

For further details write to:

ARMSTRONG WIRELESS & TELEVISION CO. LTD.

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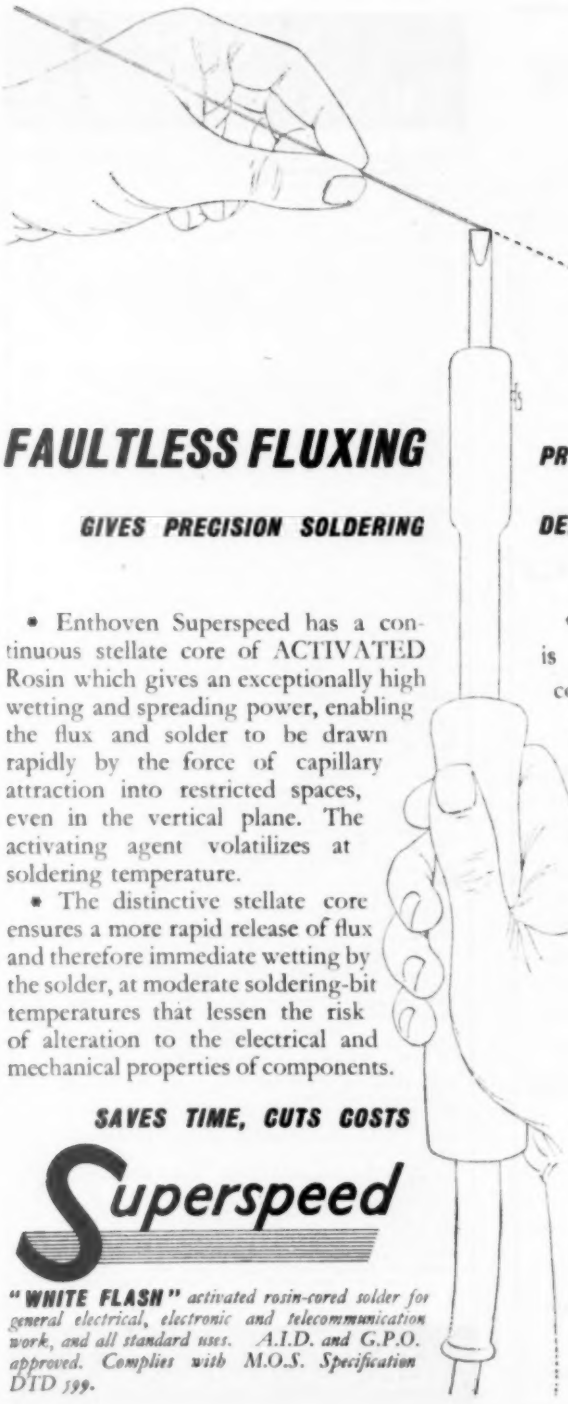

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GIVES PRECISION SOLDERING

• Enthoven Superspeed has a continuous stellate core of ACTIVATED Rosin which gives an exceptionally high wetting and spreading power, enabling the flux and solder to be drawn rapidly by the force of capillary attraction into restricted spaces, even in the vertical plane. The activating agent volatilizes at soldering temperature.

• The distinctive stellate core ensures a more rapid release of flux and therefore immediate wetting by the solder, at moderate soldering-bit temperatures that lessen the risk of alteration to the electrical and mechanical properties of components.

SAVES TIME, CUTS COSTS

Superspeed

"WHITE FLASH" *activated rosin-cored solder for general electrical, electronic and telecommunication work, and all standard uses. A.I.D. and G.P.O. approved. Complies with M.O.S. Specification DTD 599.*

PRECISION SOLDERING DEMANDS Superspeed

• The flux in Enthoven Superspeed is always released in exactly the correct proportion. Dry and H.R. joints due to underfluxing or overfluxing cannot occur. One application of Superspeed always does the job effectively.

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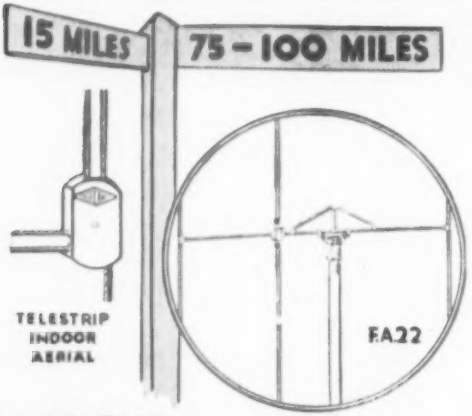

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ALL PRIMARIES ARE 200 250 v. Half Shrouded.

HSM63. (Midget). Output 250-0-250 v. 60m/a., 6.3 v. at 3 amps., 5 v. at 2 amps. 18/-
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HS40. Windings as above. 4 v. at 4 amps., 4 v. at 2 amps 18/6
Output
HS2. 250-0-250 v. 80m/a. 21/-
HS3. 350-0-350 v. 80 m/a. **HS30.** 300-0-300 v. 80 m/a. 21/-
HS2X. 250-0-250 v. 100 m/a. **HS75.** 275-0-275 v. 100 m/a. 23/-
HS30X. 300-0-300 v. 100 m/a. **HS3X.** 350-0-350 v. 100 m/a. 23/-

Fully Shrouded

FSM63. (Midget). Output 250-0-250 v. 60 m/a., 6.3 v. at 3 amps., 5 v. at 2 amps. 18/6
Output
FS2. 250-0-250 v. 80 m/a. 23/-
FS30. 300-0-300 v. 80 m/a. **FS3.** 350-0-350 v. 80 m/a. 23/-
FS2X. 250-0-250 v. 100 m/a. **FS75.** 275-0-275 v. 100 m/a. 25/9
FS30X. 300-0-300 v. 100 m/a. **FS3X.** 350-0-350 v. 100 m/a. 25/9
All the above have 6.3 4-0 v. at 4 amps., 5-4-0 v. at 2 amps.
FS43. Output 425-0-425 v. 200 m/a., 6.3 v. 4 amps., C.T. 6.3 v. 4 amps., C.T. 5 v. 3 amps. Fully shrouded. 51/-
FS53. Output 450-0-450 v. 250 m/a., 6.3 v. 2 amps., C.T. 6.3 v. 4 amps., C.T. 5 v. 3 amps. Fully shrouded 75/-
F30X. Output 300-0-300 v. 80 m/a., 6.3 v. 7 amps., 5 v. 2 amps. Framed. Flying leads. 31/9
F35X. Output 350-0-350 v. 250 m/a., 6.3 v. 6 amps., 4 v. 8 amps., 4 v. 3 amps., 0-2-6.3 v. 2 amps. Fully shrouded. 71/6
FS160X. Output. 350-0-350 v. 160 m/a., 6.3 v 6 amps., 6.3 v. 3 amps., 5 v. 3 amps. Fully shrouded. 47/6
FS43X. Output. 425-0-425 v. 250 m/a., 6.3 v. 6 amps., 6.3 v. 6 amps., 6 v. 3 amps. Fully shrouded. 69/-
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F36. Output, 250-0-250 v. 100 m/a., 6.3 v. 6 amps., C.T. 5 v. 3 amps. Fully shrouded. 32/6
FS120. Output, 350-0-350 v. 120 m/a., 6.3 v. 2 amps., C.T. 6.3 v. 2 amps., C.T. 5 v. 3 amps. Fully shrouded. 33/-
FS256. Output, 250-0-250 v. 80 m/a., 6.3 v. at 6 amps., 5 v. at 3 amps. Fully shrouded. 30/9
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FS153. 350-0-350 v. 150 m/a., 6.3 v. 4 amps., 5 v. 3 amps. 34/9
FS153X. Output, 350-0-350 v. at 150 m/a., 6.3 v. at 2 amps., C.T. 6.3 v. at 2 amps., C.T. 5 v. at 3 amps. Fully shrouded 34/9
The above have inputs of 200/250 v.

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F24. Output, 24 v. tapped 12 v. at 3 amps. 26/-
F12 and F24 framed with Flying Leads.
FU6. Output, 0-2-4-5-6.3 v. at 2 amps. 11/-
F29. Output, 0-2-4-5-6.3 v. at 4 amps. 20/9
FU6 and F29 clamped with Flying Leads.
F5. Output, 6.3 v. at 10 amps., or 5 v. at 10 amps., or 12.6 v. at 5 amps., or 10 v. at 5 amps. 37/9
F64. Output, four at 6.3 v. tapped at 5 v. at 5 amps. per winding giving by suitable series and parallel connections 24 v. at 5 amps., 20 v. at 5 amps., 18 v. at 5 amps., 15 v. at 5 amps., 12.6 v. at 10 amps., 10 v. at 10 amps., 6.3 v. at 20 amps., 5 v. at 20 amps. 57/-
F5 and F6/4 framed with Flying Leads.
FU12. Output 0-4-6.3 v. 3 amps. **FU24.** Output 0-12-24 v. 1 amp. 19/6
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HOP1. Ratios, 26, 46, 56, 66, 90, 120-1 50 m/a. max. current. C.T. for Q.P.P. Class B, etc. Secondary 2.4 ohms. Top panel and clamped, each 6/-
OP1. Midget Power Pentode, ratios 30, 60, 90-1, 40 m/a. Secondary 2.3 ohms, each 4/-
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Williamson's O.P. Transformer to Author's specification £4/13/6
Chokes for Williamson's Amplifier. 30H. at 20 m/a. 18/6
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Choke C4. 60 m/a., approx. 8H., 350 ohms 5/-
Choke C5. 40 m/a., approx. 5H., 350 ohm 5/-
Choke C6. 50 m/a., 50H., 1,500 ohms 22/-
C8. 360 Micro henries clamped. **S3. C7.** 90 m a 180 ohms, clamped 6/3
Belling-Lee Co-Axial Plugs. Type 642.F., each 1/3
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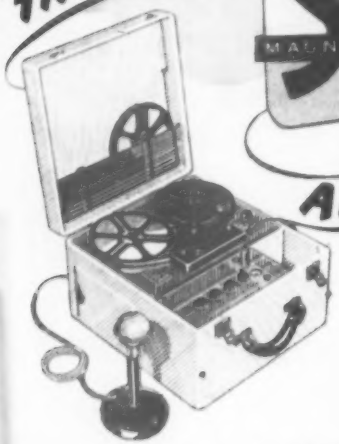

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The KT66 is a versatile power tetrode with a number of useful applications. It may be used in the output stage of an audio-frequency power amplifier, either tetrode-connected for maximum sensitivity and power output or triode-connected for high quality working. In transmitting circuits using frequencies up to 30 Mc/s it may also be used as an oscillator or as a radio frequency amplifier.
A high slope, indirectly heated beam tetrode, the KT66 is suitable for either single or push-pull audio operation and may be employed as a beam tetrode with aligned grids. This alignment of the grids reduces losses in the screen and makes for the highest possible power conversion efficiency. With this system of construction high orders of power output may be obtained with a low screen dissipation, and the anode is designed to dissipate 25 watts continuously with a reliable life performance.
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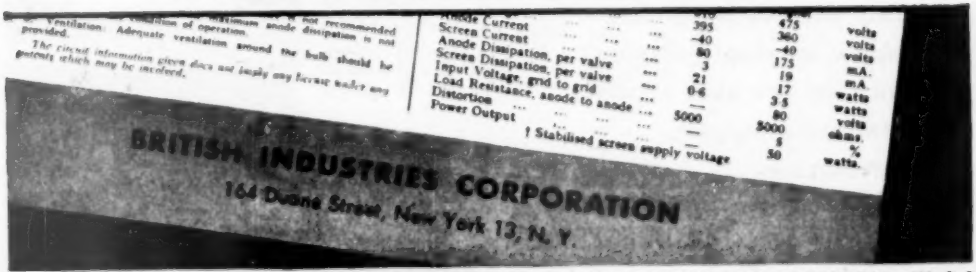
3: Anode
4: Screen Grid, g2
5: Control Grid, g1
6: Omitted
7: Heater
8: Cathode
View looking on underside of base.
All dimensions are in mm. and are the maximum except where otherwise stated.
RATINGS
Tetrode connected
Triode connected
Heater Voltage
Heater Current
Anode Voltage
OPERATING CONDITIONS
Single Valve A.F. Amplifier
Tetrode connected
Triode connected
Anode and Screen Voltage 250 400 250 volts
Bias Voltage ... ... -15 -38 -19 volts
Anode Current ... ... 85 63 60 mA
Screen Current ... ... 6.3 — — mA
Input Voltage ... ... 15 38 19 volts peak
Bias Resistance ... ... 160 600 315 ohms
Anode Load Resistance ... 2200 4500 2750 ohms
Distortion ... ... 9 7 6 %
Power Output ... ... 7·25 5·8 2·2 watts
Two Valves Push-Pull, A.F. Amplifier.
Tetrode connected, Auto Bias.
(Data per pair of valves unless otherwise stated.)
Anode Voltage

THE FAMOUS KT66 . . . IN USE ALL OVER AMERICA AND ACKNOWLEDGED TO BE THE FINEST BEAM TETRODE EVER MADE

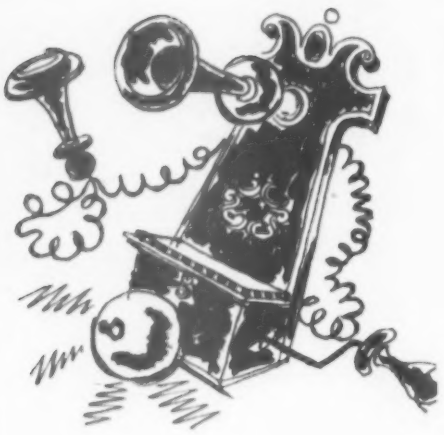
IS AN Osram VALVE MADE IN ENGLAND

The photographic reproduction is taken from literature published in America by the British Industries Corporation and gives an entirely unsolicited tribute to this fine valve.


Ventilation: Adequate ventilation around the bulb should be provided.
The circuit information given does not imply any license under any patents which may be involved.
Anode Current 395 475
Screen Current ... ... -40 360 volts
Anode Dissipation, per valve ... 80 -40 volts
Screen Dissipation, per valve ... 3 175 mA.
Input Voltage, grid to grid ... 21 19 mA.
Load Resistance, anode to anode ... 0·6 17 watts
Distortion ... ... — 3·5 watts
Power Output ... ... 5000 80 volts
† Stabilised screen supply voltage — 5000 ohms.
— 5 %
50 watts.
BRITISH INDUSTRIES CORPORATION
164 Duane Street, New York 13, N. Y.

THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, LONDON, W.C.2

THE MAN THE MACHINE AND PARMEKO



Ringing the Bell!

When the voice of Man first carried, faint and cackling beyond the human range, few saw the potentiality of a great industry of communication. The few had courage and conviction, and to them we owe our telephones. Parmeko, from their beginning, lent to these pioneers specialized aid; and Parmeko Transformers are designed by men devoted solely to that task; are produced on single-purpose plant, and are used by most of Britain's largest manufacturers.

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Apart from actual receiver faults there are three main causes of "flutter."*

ROD MOVEMENT: High winds will bend the rod elements to some extent and thus vary the distance between aerial and reflector or director. This may cause the gain of the aerial to fluctuate continuously. The "Antex" is almost completely immune from this fault since because of its unique design the free ends of the aerial rods are so far apart that the effect of "whip" is negligible. The ¼" dia. high tensile aluminium rods used are also specially loaded to eliminate "howling."

AIRCRAFT: Aircraft in the vicinity may reflect a signal towards the aerial. The movement of the aeroplane will alter the phase of this reflected signal and cause continuous rise and fall in the total signal at the receiver. It has been said that the "Antex" because of its shape and polar diagram is prone to this type of interference. Theoretically this may be true when the aeroplane is in one particular direction relative to the aerial but in practice the effect is negligible. Dealers near busy airfields confirm this.

POOR CONNECTIONS: Perhaps the commonest cause of "flutter" is bad contact due to corrosion at the aerial terminals. This is prevented in the "Antex" by the use of a weatherproof Junction Unit in which all connections are sealed and protected. They can, however, be readily examined without the necessity for dismantling the aerial assembly.

** "Flutter" is characterised by sudden variations of brightness of the screen.*

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(6ft. mast)
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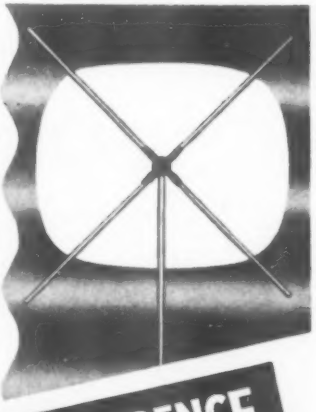
Chimney Lashing
(6ft. mast)
X3L ... £4 8 6

Chimney Lashing
(10ft. mast)
X2M ... £6 3 6



Full details in Leaflet E/50.W

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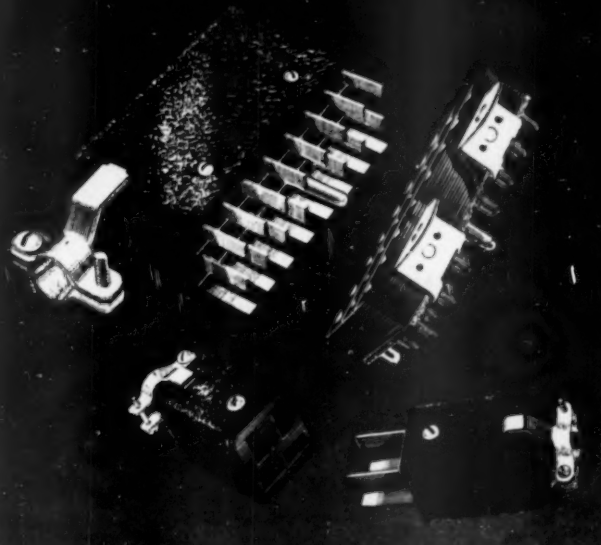

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R	½ watt	1-watt	250	10 ohms to 10 megohms	12" × 4" × 4"

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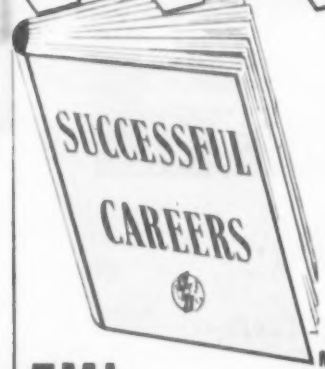

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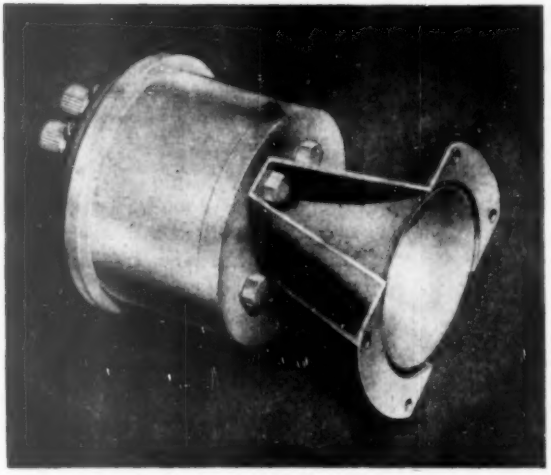

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Speech coil impedance: 15 or 30 ohms. Response: 2000/14000 c.p.s.
Flux density: 14,000 gauss. Power handling capacity: 3 watts.

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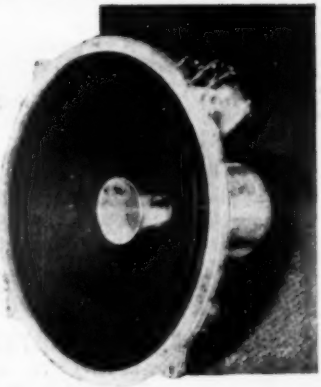

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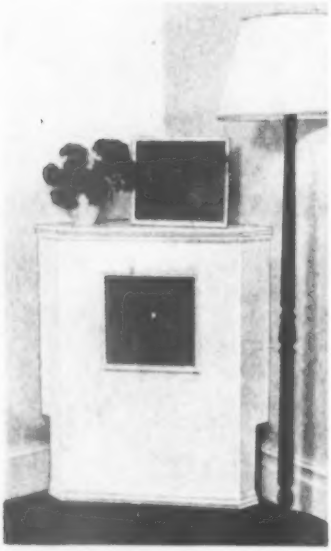

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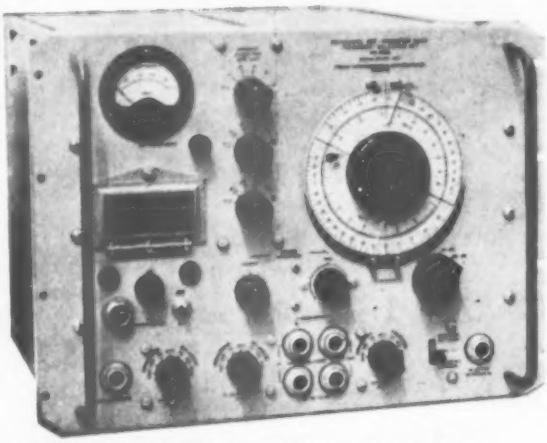

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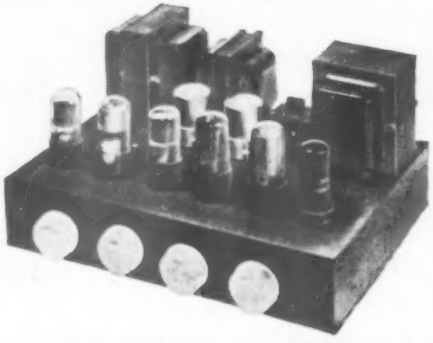

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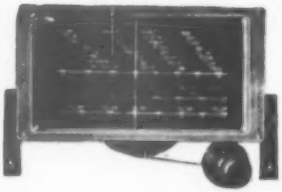

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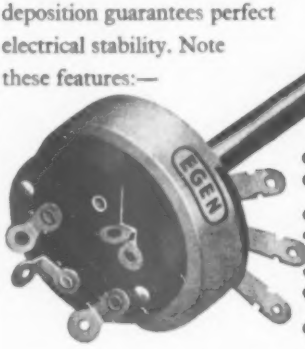

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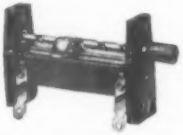

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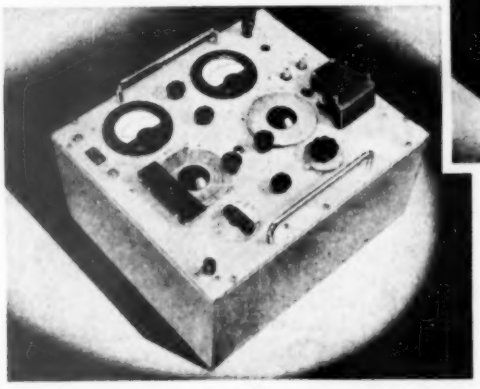
OPERATING FREQUENCIES: 50 kc/s to 50 Mc/s
DIRECT MEASUREMENT RANGES

Q: 10 to 500
Tan δ: 0 to 0.1
Capacitance: 0 to 416μμF

Inductance and resistance may be determined indirectly; for measurements at frequencies up to 170 Mc/s, use H.F. Circuit Magnification Meter Type TF 886A.



TF868

OPERATING FREQUENCY: 1 kc/s
DIRECT MEASUREMENT RANGES

Q: 0.1 to 10 (=10 to 0.1 tan δ)
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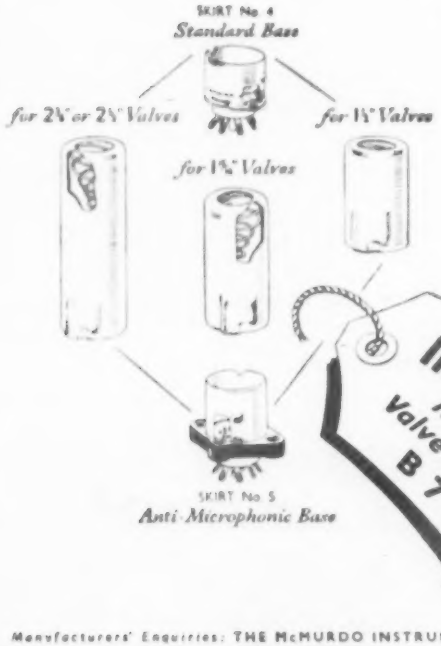

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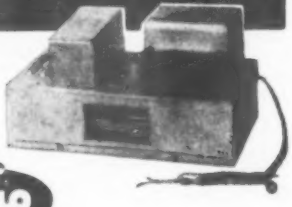

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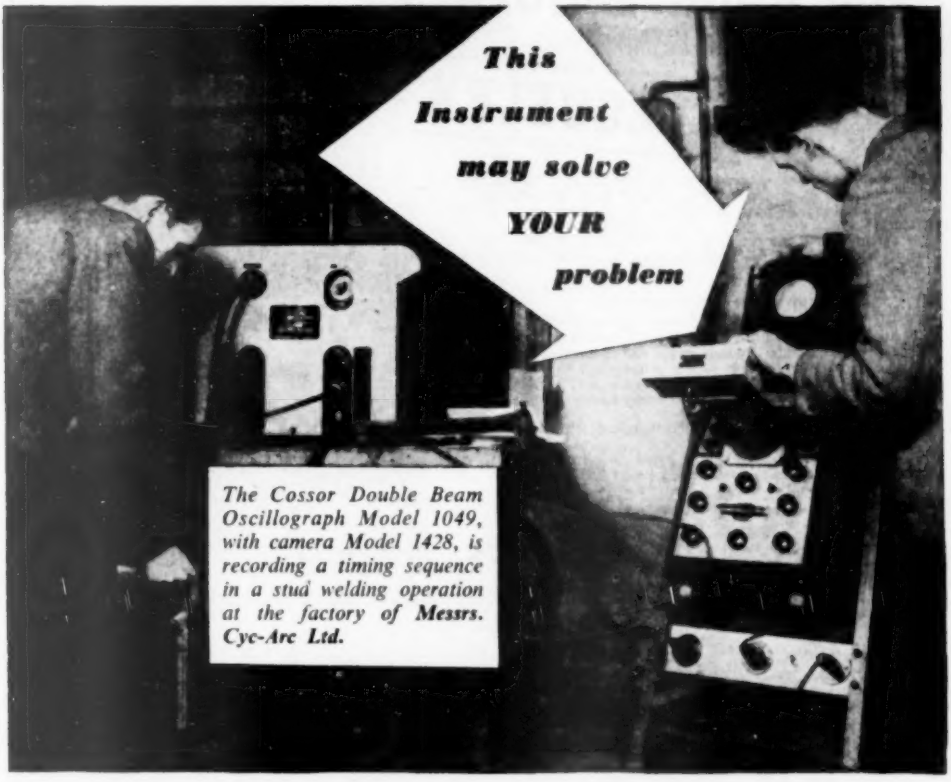

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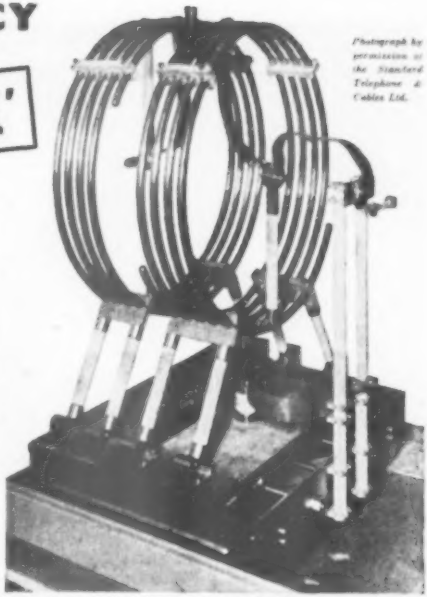

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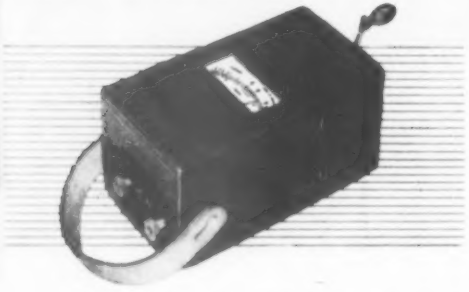

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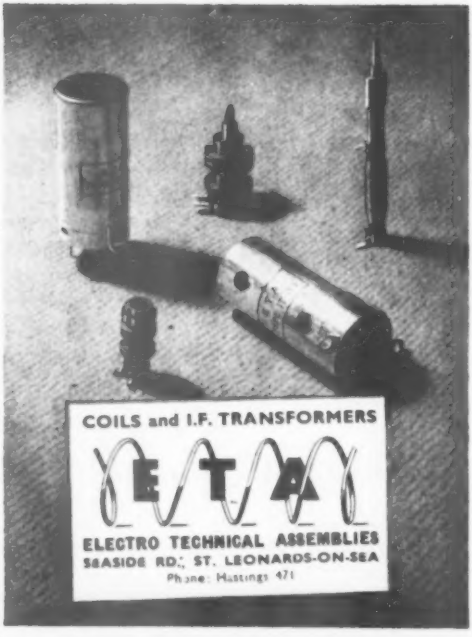

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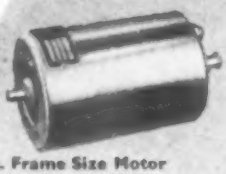

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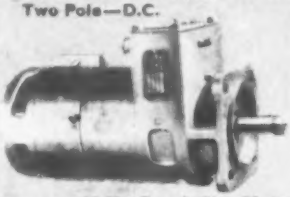

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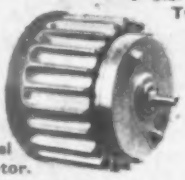

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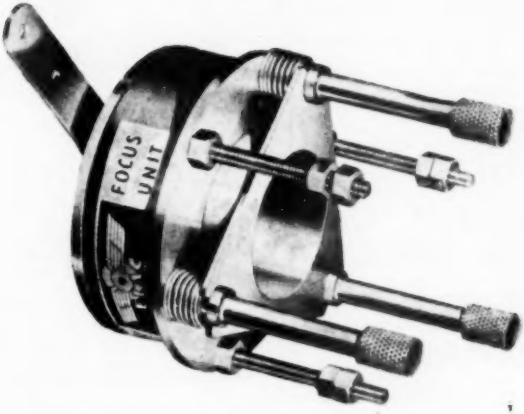

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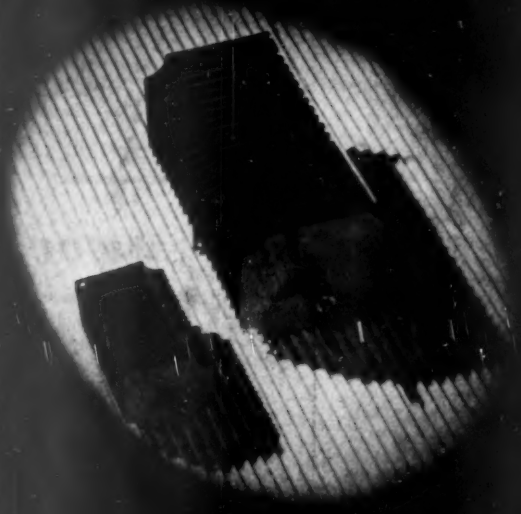

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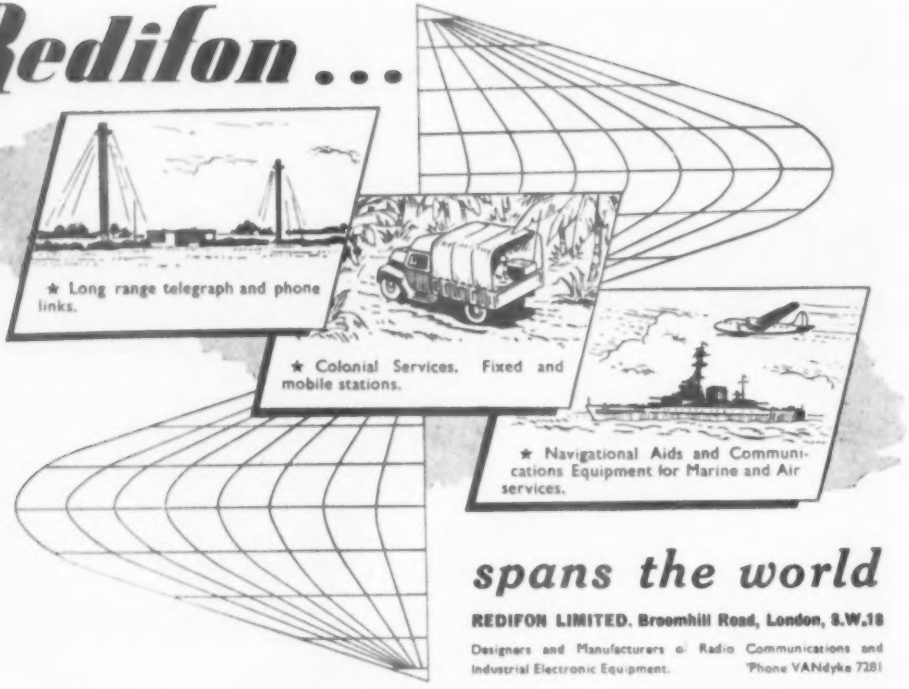
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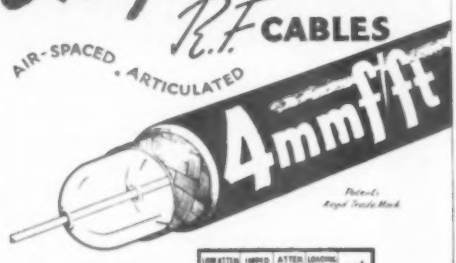

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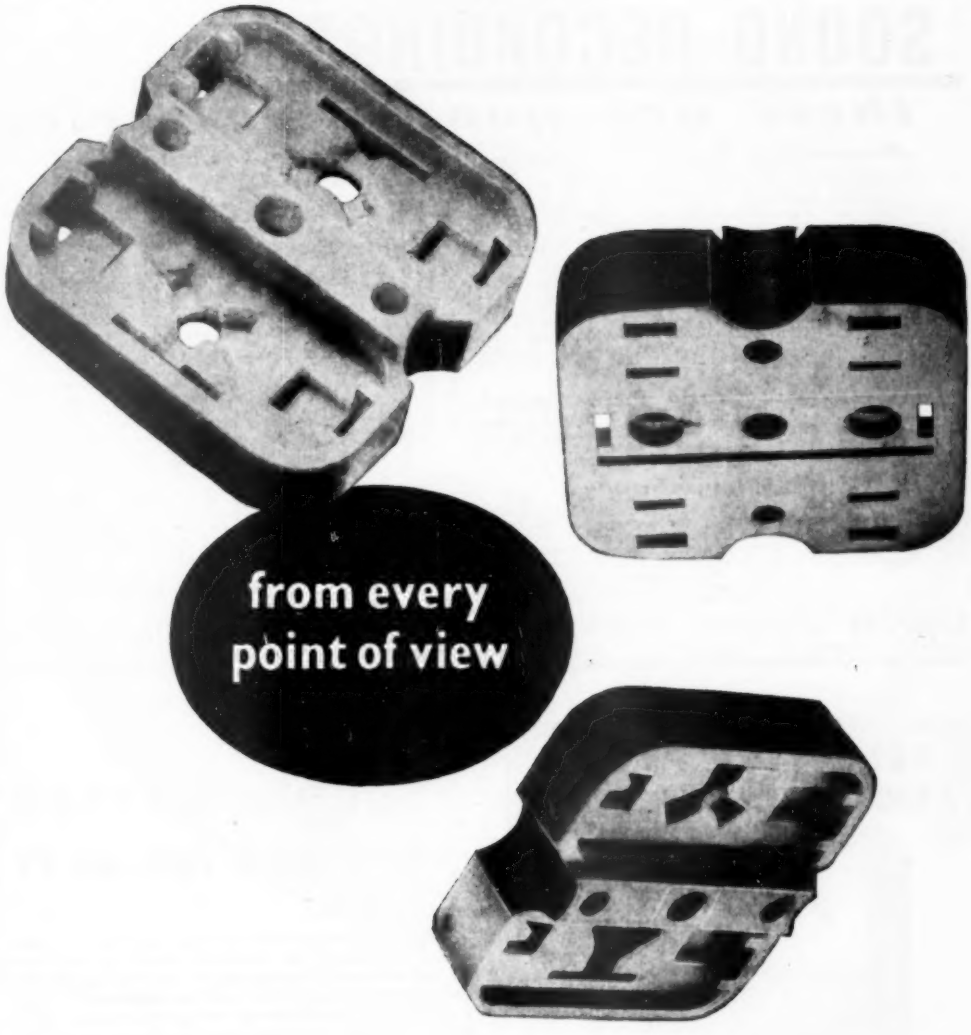

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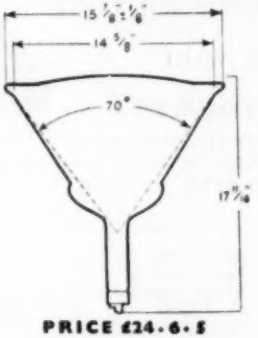

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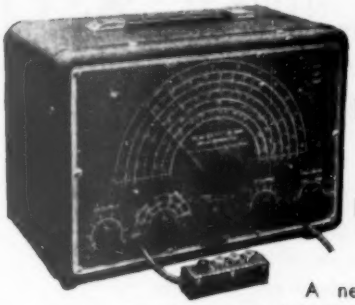

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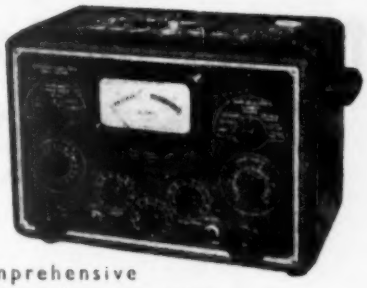

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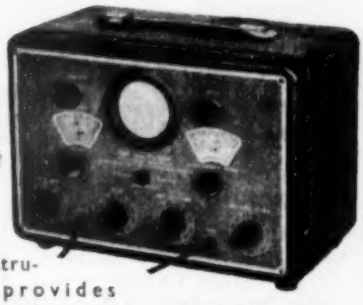

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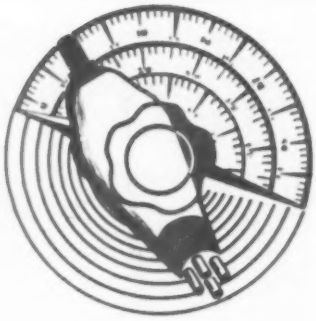

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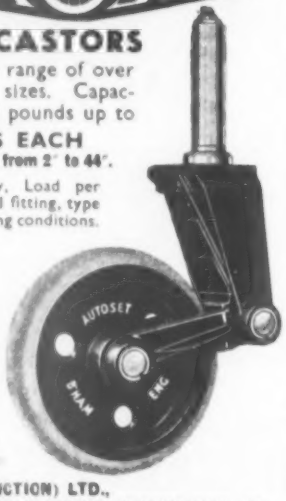

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12-inch 15w. P.M. Loudspeaker

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The very much improved acoustic properties of this the latest in the famous range of AXIOM High Fidelity Loudspeakers command the admiration of all those who require quality and value in a speaker.

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This new AXIOM is a marked advance on past models and is suitable for use with all good quality amplifiers.

Special reflex cabinets have been designed with speaker aperture at optimum listening height.

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Frequency Coverage	30/15,000 c.p.s.
Overall Diameter	12 3/16" (31.3 cms.)
Overall Depth	6 15/16" (17.6 cms.)
Fundamental Resonance	35 c.p.s. nominal.
Voice Coil Diameter	1¾" (4.4 cms.)
Voice Coil Impedance	15 ohms at 400 c.p.s.
Max. Power Capacity	15 watts peak A.C.
Flux Density	14,000 gauss.
Total Flux	158,000 max.
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You are invited to write for details of the Axiom 150 Mk. II and the specially designed reflex cabinets.

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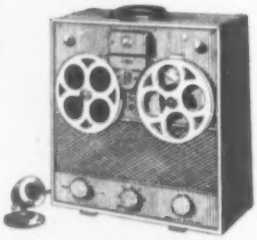

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Dear OMs,

I am now in a position to report on your very FB PR-120-V transmitter.

I am pleased to say it has and is giving very good service under the most adverse conditions. During an afternoon with a temperature of 124 degrees F. *in the shade* I took the TX into the direct sunlight. The metal casing soon became far too hot to touch (180 *degrees F.*)! An egg was broken on the lid and was cooked in about ten minutes. Under these conditions I had 5 & 9 plus from VU, VS2, ZB1, & 11. The contacts were on phone *and the VFO remained as stable as a rock.* (14 mcs.)

The following week we experienced a sand storm. Dust and sand got in everywhere. About 4lb. of sand was later removed from the TX. *It worked perfectly right through the storm.*

The first YI-G 21 mcs. contact was made using this TX.

Last week ET3R in Addis Abbaba put out a CQ. The phone give B.B.C. quality and on CW T9. I am more than satisfied and don't understand how you do it.

"spivs" came down. I had at the time a 40 metre dipole on the TX and ET3R was on 14 mcs. phone. I quickly tuned the TX on 14 mcs. and still using the 7 mcs. dipole gave him a call. About 12 other stations were calling. He came back to me and gave me 8-9 and said: "There were many stations calling me OM, but as you were the loudest I have come back to you." This *on a mis-matched antenna!!?* The very same thing happened half an hour later when KA2OM called CQ.

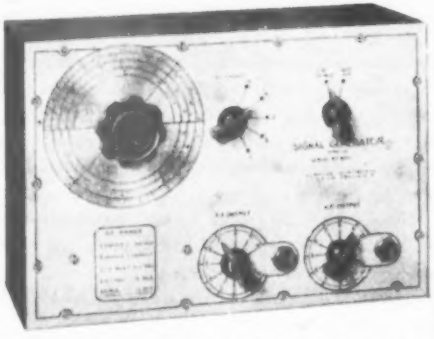
This TX seems to work like a 1 *KW TX.* All reports on

You are quite at liberty to use the above facts as you will and if you want any other details I will be only too happy to supply.

Yours sincerely,

(Signed) Michael Faraday,
YI2AM, ex YI3BZ, ex G3BUX.

The above is a copy of an original letter entirely unsolicited, received by us, and re-printed without comment. The italics are ours.



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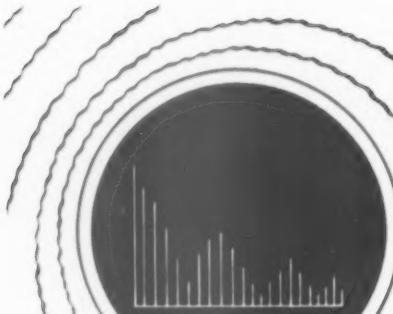

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Speech coil impedance, 3 ohms at 400 cycles.
Frequency response chosen to suit requirements.

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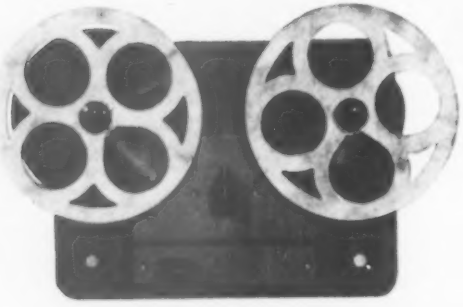

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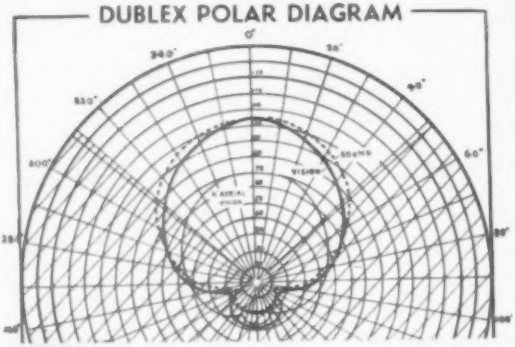
Max./Min. Ratio 25 dB.

Acceptance Angle 96°.

DUBLEX POLAR DIAGRAM



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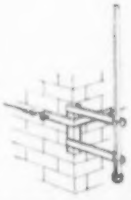

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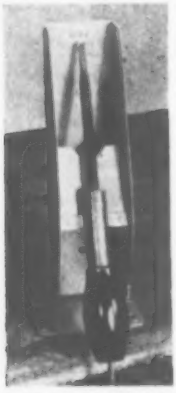
WELDING MACHINES

(Regd. Trade Mark)

SOLDERING INSTRUMENTS



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SOUND Joints For SOUND Equipment

Any volt range supplied 6/7 to 230/250

- 1/4" dia. bit Standard Model
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- Equally suited to daily or intermittent use
- Heating time: 90 seconds
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- Total length of instruments: 9 inches
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With Full Length Doors **£14.0.0**
Universal Model for all 16" tubes now in preparation.
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Fitted with shelf for easy mounting. These are **NOT** mass produced and dimensions can be altered to suit personal requirements.

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Deflection	*electromagnetic*
Focus	*electrostatic*
Vh	6·3 *V*
Vg (cut-off)	−50 *V*
Va1	1200 *V*
Va2 (focus)	800/850 *V*
Va3 (wall)	1200 *V*
V target	1160/1200 *V*
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Resolution better than 500 lines
Video Signal 0.5μA peak to peak (min)

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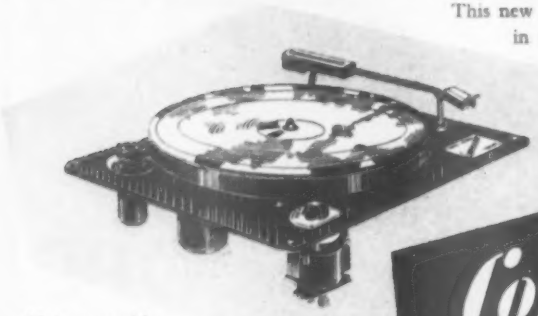
REGISTERED TRADE MARK

the Connoisseur 3-speed *gramophone motor*

This new motor unit is another noteworthy achievement in the "Connoisseur" tradition. Full 12" turntable 33⅓, 45 and 78 r.p.m. The synchronous motor is virtually vibrationless and suitable for standard, transcription and microgroove recordings.



Connoisseur

Main turntable spindle, precision ground and lapped, runs in phosphor-bronze bearings. Low noise level and hum induction. Input voltages: 200-250 A.C. 50 cycles or 60 cycles to order at no extra charge.

Price without pick-up £16.10.0 plus £7.3.0 P. Tax

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Adaptor sleeve for "Connoisseur" Dual Speed Motor to give the third speed of 45 r.p.m. now available at a cost of 2/- inclusive of postage.

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Type BM.17 ..... Price 39/-

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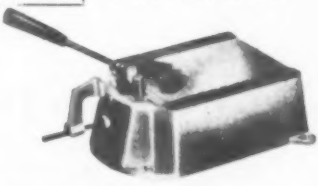
CABLE STRIPPER

Specially designed for cables up to ⅜" dia. having solid or inflexible conductors

★ The Bench-Type Cable Stripper is easily secured to bench or table and requires no skill to operate. One quick operation strips rubber insulation, asbestos or plastic from cables up to ⅜" diameter without scarring or nicking the conductors. Can also be used for flat twin or other type of cable.

Send for illustrated leaflet.

For insulated wires and flexible cables, up to about ¼" diameter, ask for details of the Foot-Operated Wire Stripper.



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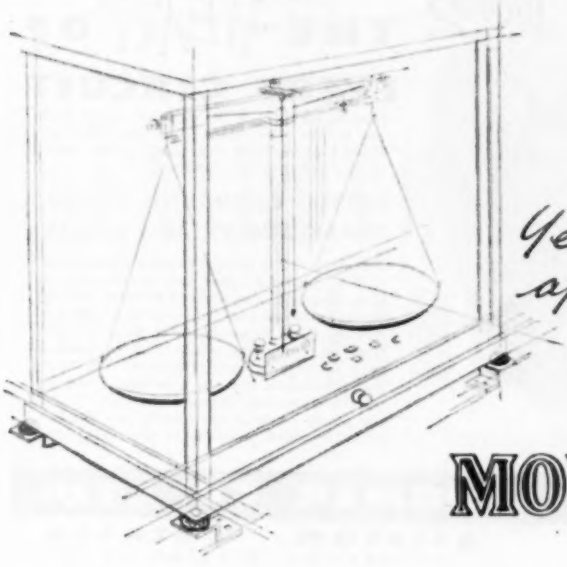
Advertisement of J. B. Hyde & Co. Ltd., Wythenshawe, Manchester.

APPLICATION 93
SERIES 38



Yet another application of a

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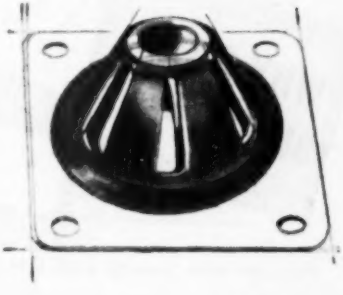
MOUNTINGS
SERIES 38

IN this instance the Series 38 "Flexilant" Mounting protects a delicate instrument from vibration and shock. Other applications are manifold — from aircraft to power-station instrument panels: from ship's instruments to the protection of pyrometers in a steel works.

We produce a range of components that absorb vibration; eliminate noise; suppress shock. Our new catalogue lists all these for you.



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is to be found in its Transformer, which, like the human heart must keep the lifeblood flowing evenly and constantly under both normal and abnormal conditions.

POTTED COMPOUND FILLED TRANSFORMERS AND CHOKES

manufactured by WODEN have been designed to fulfil such a purpose, and for this reason they have been standardized by many leading Radio, Television and Electronic manufacturers and also Government Research Departments. Their choice is only made after exhaustive tests for accuracy and reliability. To merit this confidence, there is a constant need to provide components of the highest quality and our ample research and testing facilities ensure continued progress in this direction.

Send for our fully illustrated Catalogue

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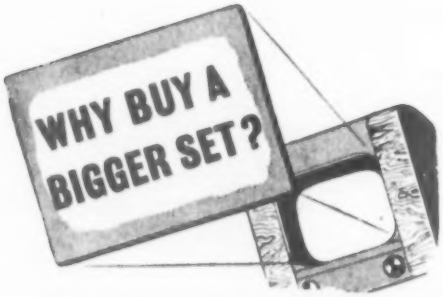

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A Magnavista Lens enables you to get "big set" viewing from a medium-sized set. This optically computed lens gives larger, clearer pictures without turning up the brilliance. It has a built-in filter for daylight viewing. The Magnavista saves you tens of £1's, yet you can buy one from as little as £5. 5. 0 from all good dealers.

The New MAGNAVISTA Filtachromatic Television Lens

A product of

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The WILLIAMSON Amplifier

We have been given a laboratory report of a Williamson Amplifier, our type GW18C, which was submitted to intermodulation tests. The results using an Altec Lancing Intermodulation Distortion Meter and Boonton Beat Frequency Oscillator were :—

I.M. Distortion	Power Output	Frequency Ratio 1 : 4
2%	15 watts	40 & 2,000 c/s.
0.3%	10 watts	40 & 2,000 c/s.
0.9%	15 watts	100 & 2,000 c/s.
0.2%	10 watts	100 & 2,000 c/s.

This is the first time to our knowledge, Intermodulation Distortion figures have been published in this country and compared with similar American amplifier data they are considerably lower than those for any other type.

The report on the Goodsell pre-amplifier showed it to be a comparable unit with similar figures.

The importance of these points reveal themselves with startling clarity in listening tests.

Demonstrations at :—

Webb's Radio, 14, Soho Street, London, W.1.
The Classic Electrical Co. Ltd., Lr. Addiscombe Rd., Croydon.

GOODSELL LTD.,
40, Gardner Street, Brighton
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which, from October 15th, 1952, is to handle expanding sales throughout the world and to maintain the highest possible level of service to customers

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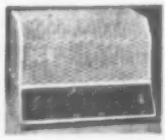
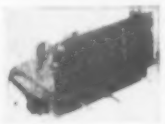
"LINCOLN" HI-FI AMPLIFIER



A novel arrangement in this amplifier permits connection of output valves as either TRIODES or TETRODES with outputs of 3 or 10 watts. Bass and Treble lift and cut. Negative feedback.
PRICE : 18 Gns.

THE "LINCOLN" TUNER



Three waveband high quality radio unit. 3 positions of selectivity. Maximum bandwidth 18 Kc/s. Gram. pre-amplifier with compensation for L.P.'s and 78's.
PRICE : £19/15/-.
(Pur. Tax £7.11.7).

ALL VIEWMASTER COMPONENTS in stock for ALL STATIONS.

"Q-MAX" CHASSIS CUTTERS for cutting holes easily in sheet metal. Sizes from ⅜in. to 2½in. round and 1in. square. Full list on application.

THE "LINCOLN" OSCILLATOR COIL

Completely enclosed in "Neosid" former ensuring minimum external field. Unusually good waveform with maximum amplitude at 45 Kc/s. Lettered tag panel connections and one-hole fixing.

Overall size, 1⅝in. x 1⅝in. x 1in. PRICE 12/6. (Post 6d.).

"Q-MAX" MODEL G.D.O.I. GRID DIP OSCILLATOR

is an ideal instrument for the determination of tuned circuit resonant frequency, tuning transmitters without application of power, for the determination of coil, mutual and stray inductances and both fixed and stray capacitances. Covers 1.5 to 300 Mc/s in eight ranges. PRICE : **12 Gns.** Complete.

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Amplifiers, pre-amplifiers and Tuner units.

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Crystal, Moving Coil and Ribbon in all makes.

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We can now supply
ALL PARTS
for you to build your
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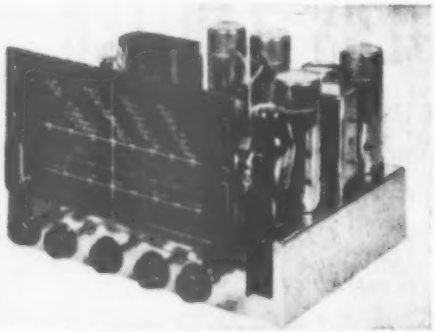

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* ALL PARTS AND UNIQUE "EASY AS A.B.C." CONSTRUCTION SHEETS AVAILABLE. REMEMBER, NO COMPLICATED ALIGNING OR TEST GEAR REQUIRED !

NOTE for Connoisseurs :—Our 40 FEEDER UNIT, with r.f. stage and Hi-Fi switching for local stations, and 10 w push-pull QUALITY AMPLIFIER with variable negative feedback is the TOPS ! ! !

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This is definitely the best value on the market to-day ! All items can be supplied *from stock*. DON'T DELAY—SEND NOW TO Dept. W.W.N.

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Those Interested are Invited to send for Illustrated Leaflet.

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PROJECTOR
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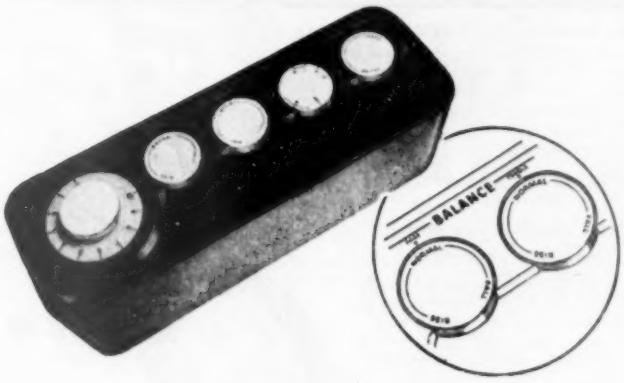
★ A POINT OF DETAIL NO. 1 ★



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It is a common misunderstanding that frequency correction can be directly related to reproduced volume level. This is of course not the case. The optimum volume level of reproduction depends upon the apparent distance of the sound which in turn is controlled by the reverberation and acoustic arrangements in the studio. It is the aim of studio engineers to provide an apparent distance so that natural sound level at that distance will be a comfortable listening level under normal listening conditions.

It follows from the above that under average conditions only very small amounts of balance adjustment will be needed and it is easily shown that small amounts in extent require very gradual slopes. The bass control of the Q.U.A.D. simultaneously varies the slope and the extent of bass response following very closely ideal requirements.

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A switched level position is provided without altering control setting so that a reference standard is available during adjustments.

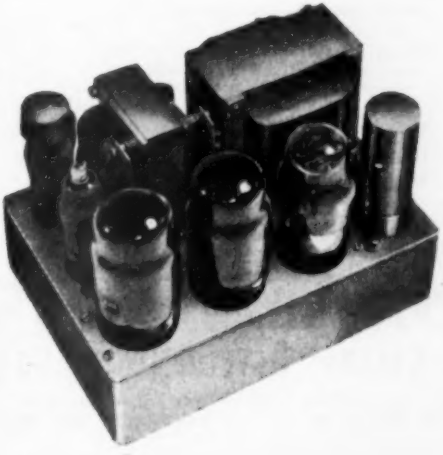
The two remaining controls provide adjustment for the upper frequency limit of harmonics and the slope of tail off above this frequency limit ONLY IN THIS WAY CAN ONE OBTAIN THE WIDEST POSSIBLE FREQUENCY RANGE FOR A GIVEN DISTORTION LEVEL.

Each control is checked throughout its range to pass figures of ±0.5 db in level or ±5 per cent. in frequency which ever is the greater.

THE ACOUSTICAL Q.U.A.D. AMPLIFIER

An amplifier capable of providing the closest approach to the original sound yet achieved. Write for the Q.U.A.D. booklet for full detailed specifications.

£35 *complete in two units as illustrated.*



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miniature in size...

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Little wonder that OSMOR "Q" RANGE COILS are the "big noise"... No imitations, regardless of price, can compare with them for super selectivity and sensitivity. And you don't just have to take our word for it—the watertight guarantee makes your satisfaction certain! Consider these points of superiority:—

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★ Packed in damp-proof containers.
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★ Low loss Polystyrene formers.
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COILPACKS. A full range is available for Superhet and T.R.F. Mains or Battery. Size only 1¾in. high × 3¼in. wide × 2¾in. Ideal for the reliable construction of new sets, also for conversion of the 21 RECEIVER, TR 1196, TYPE 18, WARTIME UTILITY and others.

Aligned and tested, with full circuits, etc. Fully descriptive leaflets available.

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Send 5d. (stamps) for **FREE CIRCUITS** *and full list of coils, coilpacks and radio components.*

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Minor	£11 0 0
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Detailed specifications of all the above units available post free on request.

Available through leading dealers in London and the Provinces, or if in any difficulty apply direct.

Trade and Export Enquiries invited.

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A **MINIATURISED** version of the well-known A.B. 'H' Type Switch.

The same utter reliability that has made its big brother famous is engineered into this switch and its complete flexibility of application makes it a 'must' in equipment where space is at a premium.

Early deliveries can be given and we cordially invite your enquiries.

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3-Speaker System

The W.15.CS Sand-filled Enclosure as illustrated is available without the treble units tax free at £47 0 0

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A 3-way ½ section Crossover unit can be supplied at (with terminals) £4 0 0

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Twin Treble Assembly, as illustrated (W.10/CS and Super 5) £30 6 2

These prices include purchase tax

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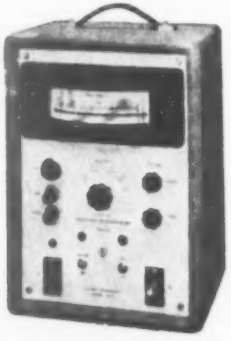
The TWENTY MILLION MEGOHMMETER

The modern instrument for the measurement of resistance. Covers the range from 0.1 to 20,000,000 megohms in six decades. Two test voltages, 85v and 500v are provided and a six-inch mirror scale meter enables readings to be taken accurately and quickly. The instrument is especially useful for testing cables, resistors, condensers, and all insulating materials.



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Particularly for RCA Transmitters ET 4336 and Hallicrafter BC.610.

We shall be pleased to receive your enquiries.

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METERS—FERRANTI Moving Coil Meters 0-500 micro-amps, Dia. 2½", Flush mounting. 45/- each.

HALLICRAFTER SX28 & RCA AR88 S Meters, 45/- each.

We wish to purchase large or small quantities of American transmitter spares or complete equipment.

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MICA DIELECTRIC CAPACITORS

Eminently suitable for H.F. Transmitting and R.F. Heating Circuits.

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The example shown is a high grade, oil immersed, naturally cooled mica capacitor, designed to ensure the maximum surface cooling area for the bulk, thereby occupying the minimum of floor space.

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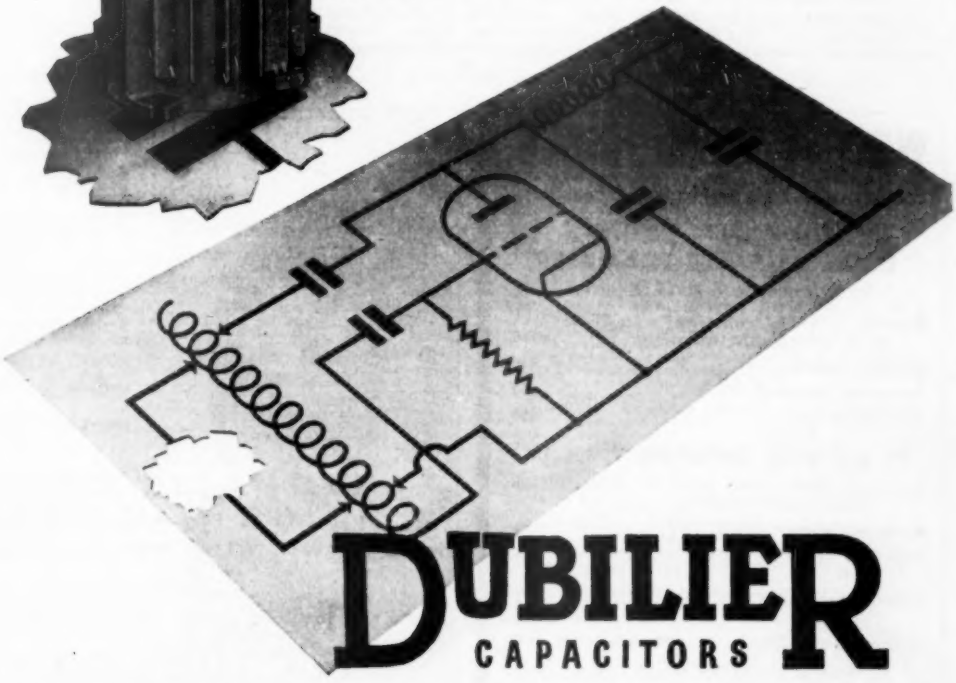
Peak Working kV	24.0	24.0
Maximum Current	70 Amps	70 Amps
Maximum kVA	350	500
Overall Height	21⅛"	31⅛"
Base Space	11¼" × 9¼"	11¼" × 9¼"

Full details of these and other outstanding Capacitors are available upon application.



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Dub

non-microphonic cables

In certain applications of small flexible cables it has been found that the cable itself is the source of minute parasitic voltages, generated chiefly when the cable is flexed, vibrated or knocked. This is important in the case of leads carrying very small signals, of the order of say, 10^{-10} amps.

Telcon offers a new range of cables having a Telcothene insulant provided with a low-resistive covering adhering to the cable core immediately under the braid. With this construction it has proved possible to utilise the extremely good electrical and mechanical properties of Telcothene and at the same time reduce these troublesome parasitic voltages to a level lower by 20-50 db, compared with normal polythene cables.

The following standard cables incorporating this refinement are available: K.16.GM, PT.1.GM, PT.11.GM. *Further particulars on application.*

TELCON RF cables

TELCON CTM

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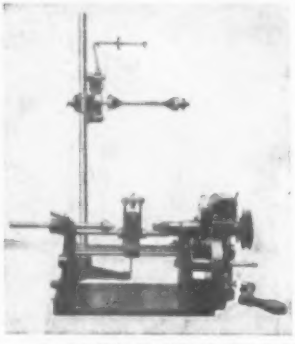

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AUTOMATIC COIL WINDING MACHINES

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Machines supplied complete with stand motor and Two-speed Friction Clutch

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MAGNETIC RECORDING SPECIALISTS

Announcing the New **BURGOYNE TRANSPORTABLE**

DUAL TRACK MAGNETIC TAPE RECORDER

★ **A new and exceptional unit designed to give the maximum performance with the minimum of trouble FOR ONLY 32 GNS.**

Although of professional performance and appearance this Recorder is designed expressly for ease of operation by the non-technical user, and incorporates an entirely new 5-valve circuit, designed for quality reproduction at good volume level.
A new feature is the inclusion of a Head-lift Transformer, which so improves the Signal to amplifier noise ratio as to be better than an extra stage!

Four controls are provided. Volume, Bass, Treble and Record Play selector. The selector switch is linked to Red and Green visual indicators in order to obviate the possibility of incorrect usage.

The Bass and Treble controls are operative on both record and play-back, providing a wide overall variation of tone correction.

The Tape Table is a 3-motor model of the latest design, and incorporates instantaneous braking which is operative under all conditions. Fast winding tape may be stopped instantly with no breakage and no slack, providing instant selection of any section of material.

A High impedance, high fidelity Rec./Play Head is fitted, with a separate AC erase head.

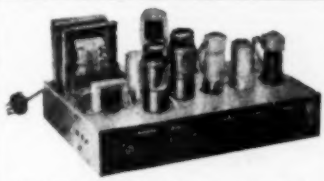
Tape speed is 7½in. per second, providing 64 minutes playing time from a standard 7in. reel—dual tracks.

The complete Recorder, in a handsome polished walnut cabinet, with Hi-Fi Xtal Microphone of new design. By Rothermell.

Complete ready to use at

32 GNS. (Carr. & Pkg. 21/-).

Inclusive of crystal microphone.
H.P. Terms £11.4.- deposit,
12 monthly payments of 42/9.



The Record/Playback Amplifier Type A6
used in this Recorder is now available at
£11.15.0 CARRIAGE PAID
fully wired and tested.
H.P. terms: Deposit £3 15 4
12 monthly payments of 16/5.

Announcing the New

BURGOYNE Mk. III TAPE TABLE

As used in the Burgoyne Tape Recorder

Following our policy of improvement in design and performance we are now distributing the NEW BURGOYNE MK. III TAPE TABLE.

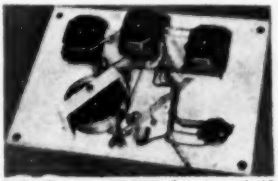
This unit incorporates a brand new feature which will make an immediate appeal to all tape recording enthusiasts.

INSTANTANEOUS BRAKING

Hitherto a feature found only on the most costly Tape Tables, for the professional, the new Burgoyne Mk. III Tape Table incorporates a positive and instantaneous brake mechanism which operates under all conditions. With the tape running at maximum speed forward or back, application of the brakes brings it to an immediate standstill, giving instant location of any section of tape, with no slack and no possibility of breakage. Another invaluable aspect is the fact that the Tape reels are held rigid when loading and unloading.

This new feature is the greatest single advance in the famous range of Burgoyne Tape Tables!!

- ★ **Three motors employed.**
- ★ **Fast forward and rewind.**
- ★ **Two High Impedance Heads (Hi-Fi Rec. Play).**
- ★ **Tape speed 7½in. per sec.**
- ★ **Spare Tape Reel.**
- ★ **Heavy balanced flywheel.**



List Price **£16.10.0** (Carr. & Pkg. 7/6) H.P. Terms: **£5.10.0** deposit and 12 monthly payments of 21/8.

We are Distributors for the

TRUVOX TAPE DESK

A new addition to the range of Truvox products with the following features:—

(1) **Three motor drive.**
(2) **'Drop-in' Tape Loading.**
(3) **Push-button control, electrically and mechanically interlocked.**
(4) **Separate push-button brake.**
(5) **Fast forward and fast re-wind without tape wear.**
(6) **Silent drive eliminating "WOW" and "FLUTTER."**
(7) **Low impedance Erase and High Impedance Record/Playback Head in one unit.**
(8) **Half track working.**

This high quality desk uses a new method of tape control and tape loading which makes it almost impossible to go wrong. Pushbutton control enables the user to either work the machine on the record/playback position or to go fast-forward or fast-reverse. In the latter two positions of the switches, a complete reel can be re-spooled in under 1 minute. A particular feature is a novel form of braking system with a separate button which will stop the mechanism instantaneously when depressed. The Desk is finished in a plastic that is washable and highly resistant to any form of mechanical damage.
The heads are so designed that the erase head works from a low impedance circuit thus ensuring satisfactory erasure and minimum loss of energy in screened cables while the record/replay head is of the high impedance type, therefore, rendering unnecessary the use of transformers.
This head is, however, tapped down so that it also received a bias voltage from a low impedance circuit.

Overall size 16½in. × 13in. Weight 12½ lbs.

List Price **£23.2.0** (Carr. & Pkg 10/-)
Or H.P. Terms:—Deposit £7/14/0 and 12 monthly payments of 29/-.

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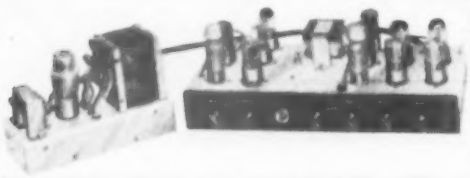

FOR THE RECORDING CONNOISSEUR

The Burgoyne record playback amplifier Kit (Type A5) using 14 valves in two completely independent amplifiers, for record and playback.
As described on previous issues.

List Price **20 Gns.**

Or H.P. terms: £7 deposit and 12 monthly payments of 26/8.

MANUAL AVAILABLE at 5/-
(Credited if Kit purchased)

RECORD/PLAYBACK AMPLIFIER KIT TYPE A4

Designed for use with high impedance record playback heads, this amplifier solves the problems of the home constructor.
In the Record position, the amplifier has provision for microphone and gramophone inputs, and a mixer circuit allowing fading and balancing between them. A Radio feeder may also be used in place of the gramophone. In the Record position, provision is made for monitoring on headphones, the material being recorded. The use of headphones eliminates feedback problems usually associated with speaker monitoring.
In the Playback position the circuit is re-arranged to form a stable high gain amplifier. The playback pre-amplifier stages uses an EF37A giving extremely high signal to noise ratio, complete freedom from microphony, and negligible hum. Pre-set equaliser circuits are included, and further tonal adjustment is given by a variable tone control.
The microphone circuit is terminated in an impedance satisfactory for crystal microphones, the Acos MIC 22-1 (at £6.6.0) being particularly recommended. There is sufficient output to modulate all types of tape.
As with all M.O.S. kits, a fully detailed and comprehensive manual gives the fullest details, the kit being complete including pre-drilled chassis, nuts bolts, solder tags, and solder, etc.

KIT COMPLETE with Instruction Manual
£6.19.6
Instruction Manual only 3/9
HIRE PURCHASE
Kit as above: Deposit £2.0.0
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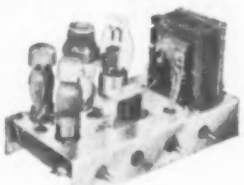

We recommend
The ROTHERMEL 2AD56
Crystal Microphone

For Tape Recording—P.A.—Amateur Radio

A new product of Rothermel with a sensitivity of minus 55 db relative to 1 v./dyne/cm². Response essentially flat from 35-9000 cs.
Overall length 5¼in.
Can be used as a Hand microphone or, by adding a base, as a Desk microphone.

Only **59/6** POST FREE

As used on the Burgoyne Portable Tape Recorder described in this issue.

A custom built Portable Tape Recorder
The CJR high quality Recording & Playback Unit Type 01
£119 : 15 : 0

Come and see this unit working at the Radio Centre H.P. terms £39 . 8 . 4 deposit 12 monthly payments of 152/6 or 18 monthly payments of 106/8.

"BURGOYNE"
OSCILLATOR COIL
For Tape Recording

With circuit diagram **8/6** Postage and packing 6d.

M·O·S "EASY-TO-BUILD" KITS

THE A1 AMPLIFIER

★ High quality output (four watts).
★ Employs three valves in a well designed circuit, and the reproduction is of the highest standard.
★ Simple stage by stage easy to follow instructions.
★ For A.C. Mains.

Complete Kit including Manual **£4 : 12 : 6** Instruction Manual **3/6** or Fully Assembled and Wired Ready to use. **£5 : 12 : 6**

THE A2 AMPLIFIER

This amplifier is an AC/DC version of the amplifier A1. Gives those on DC the opportunity to construct at very reasonable cost, an amplifier whose reproduction can be classed as excellent. The amplifier has an output of 3 watts.

Instruction Manual ... **3/-**
A2 Amplifier Kit with Manual ... **£3:5:0**
Or Fully Assembled and wired ... Ready to use. **£4:2:6**

BUILD YOUR OWN TEST METER

We have available a limited quantity of Foundation instruments with 3½in. scale, basic FSD 1 MA. which are calibrated 0-50, 0-100 volts on one scale and OHMS on another scale. They are available in flush mounting fitting either Round or Square flange and are made by a well-known manufacturer. Fully guaranteed. (NOT surplus.)

Post Free **55/-**

BURGOYNE MAGNETIC RECORDING HEADS

★ High Impedance (2,000Ω).
★ Single hole fixing.
★ Half track width.
★ Totally enclosed with tape guide.
★ Wide frequency range.
★ Record Playback or Erase types available.
★ Half-thousandth Gap.
★ Mumetal lamination on Record Playback.

Actual size of head.

39/6 each

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Laboratory developed TV Kit

A practical 5 channel 16in. TV Receiver for the Home Constructor.
Send for full size working diagrams, 6/-.
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Boxed kit Ref. TKS/6 **8 Gns.**

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A pocket size 7-range Instrument
0-300 v. A.C. or D.C. in 4 ranges.
0-50 mA. } A.C. or D.C.
0-300 mA. }
0-3 amp.

Precision built **50/-** Post paid.

BSR DE LUXE MOTOR UNIT MU15

Specification

SPEED .. .. 78 R.P.M.
MAINS INPUT 200/250 volts, 50 cycles, A.C. Other voltages and frequencies to order.
MAINS CONSUMPTION .. Approx. 10 watts
TURNTABLE .. .. 8in. diameter
NET WEIGHT .. .. 7½lb.

This unit can be used with any normal type of pick-up. Its constancy of speed and ample torque make it suitable for lightweight or the heavier types. £3 CASH.

M·O·S

B.S.R. 3-SPEED GRAMOPHONE UNIT. Type GU4, high fidelity lightweight Crystal Head

33⅓-45-78 r.p.m. speeds by switching. 4-pole induction motor. Transcription quality. Automatic stop. 10in. heavy pressed steel turntable fitted with removable rubber mat.

£9 . 19 . 11 CASH or DEPOSIT £3.6.11 and 12 monthly payments of 14/5

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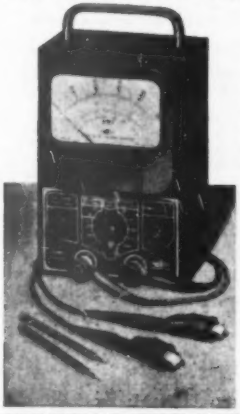
12in. MULLARD MW31 ..	£18 4 10	£6 9 0	23/-
12in. MAZDA CRM 121 A/B ..	£18 4 10	£6 9 0	23/-
12in. BRIMAR C12B (Alum) ..	£19 7 8	£6 18 0	24/-
12in. MAZDA CRM 123 (Alum) ..	£19 7 8	£6 18 0	24/-
14in. BRIMAR C14 (Alum) ..	£22 8 5	£7 10 0	28/4
14in. MULLARD MW 36/22 ..	£21 5 8	£7 5 8	26/8
16in. ENGLISH ELECT. T901 ..	£24 6 5	£8 6 5	30/6
17in. BRIMAR C17B ..	£26 19 0	£9 0 0	34/-

Add sufficient for carriage and packing by passenger train.

The PULLIN Multi-range TEST SET

Series 100



The universal testing set. Sensitivity — 10,000 ohms per volt. Strong metal case with carrying handle—complete with leads having detachable bull-dog clips and test prods.
Size 9in. × 5¼in. × 4in.

RANGES:

AC/DC volts: 10, 25, 100, 250, 500, 1,000. D.C. Milliamps: 2.5, 10, 25, 100, 500. AC/DC Microamps: 100 Microamps 10 volt range. Resistance ranges: 0-1 Meg. (13,500 ohms mid-scale). 0-10,000 ohms (135 ohms mid-scale).

11 GNS. Cash or 40/- deposit and 12 monthly payments of 20/-.

The AMPLION All-purpose TEST METER

★ **HIGHEST QUALITY MOVING COIL METER MOVEMENT**
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★ **10 RANGES**

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SENSITIVITY: 1,800 ohm per volt on all D.C. and A.C. ranges.

RANGES:

10 v. 100 v. and 500 volts D.C. and A.C.
*50 m.a. and 500 m.a. D.C.
*Resistance up to 200,000 ohm (3,000 ohm centre scale) with self-contained battery.
*5,000 Volts Range with a separate H.T. test prod (9/6 extra)
*Supplied with test prods.
*Multicolour scale easily readable.

£5

Or 20/- deposit and 12 monthly payments of 10/-. High Grade Leather Case, if required, 15/- extra.

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AUDIOM 60	£12 6 3	£4 2 0	17/-
AXIOM 150 MK. II ..	£14 13 4	£4 13 0	20/-
HARTLEY TURNER			
215	£20 15 8	£6 15 0	26/9
WHARFEDALE			
BRONZE 8in.	£3 9 3	£1 3 0	7/2
BRONZE 10in.	£5 0 4	£1 13 0	8/11
SUPER 8CS	£6 17 1	£2 5 0	11/-
SUPER 8CSAL	£7 4 4	£2 8 0	11/4
GOLDEN 10	£8 6 0	£2 16 0	12/6
GOLDEN CSB	£9 0 5	£3 0 0	13/4
W10CS or CSB, W12 ..	£13 7 0	£4 9 0	18/2
SUPER 12 CSAL	£23 1 10	£7 13 10	29/6
W15*	£15 10 0	£5 3 6	20/6
W15CS*	£16 0 0	£5 6 0	21/2
(*NOT TAXABLE)			
W.B.			
10in. CONCENTRIC DUPLEX			
LESS TRANS.	£10 3 3	£3 8 0	14/7
WITH TRANS.	£11 13 6	£3 18 0	16/3
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LESS TRANS.	£32 13 6	£10 13 0	42/2
WITH TRANS.	£34 10 0	£11 10 0	44/1

To QUICKER TV SERVICING!

The *Radar* Kilovolter, *range* 3-30 Kv.

For measurement of line-flyback, RF and Pulse EHT Systems. The Radar Kilovolter has been introduced to meet the needs of the service engineer for an inexpensive instrument to measure the EHT voltage applied to the anode of television picture tubes including the higher voltages used with projection-type tubes. The Kilovolter consists essentially of a calibrated spark gap and no load is presented at the correct setting. Safe, reliable and fully guaranteed.

£3 17 6

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Types available from stock.

You need one of our famous adjustable-focus torches all the year round and particularly at this season.

★Solid brass nickel plated cases.
★Pull out carrying loop.
★Safety switch.
★Fully guaranteed.
★Supplied with British batteries ready for use.
★Terrific beam length.

Type	Beam length	Head	No. of batteries	Price
A	700ft.	As illustrated	3	18/6
B	400ft.	As illustrated	2	15/6
G	500ft.	small head	3	15/11
H	1,500ft.	As illustrated	5	25/-
J	300ft.	small head	2	11/6

POST FREE

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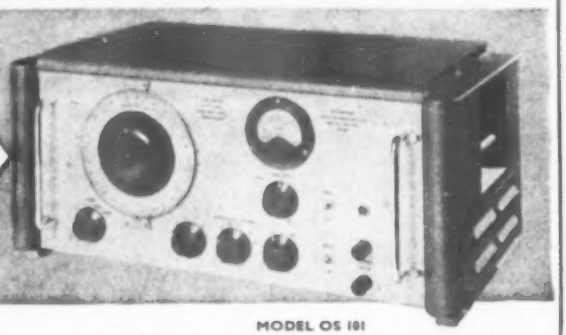
★ 25 c/s–250 Kc/s
★ HIGH STABILITY
★ BUILT IN ATTENUATOR
★ CONSTANT OUTPUT
★ LOW DISTORTION



SPECIFICATION

FREQUENCY RANGE 25 c/s to 250 Kc/s in four ranges.
ACCURACY Better than 1% or 1 c/s.
STABILITY Long term less than 0.1%.
ATTENUATOR 600Ω "T" type. Range 0-60 db in 1 db steps
OUTPUT Constant to within 1 db over full range
OUTPUT POWER 100 milliwatts into 600Ω continuously variable and monitored on 2½ in scale meter calibrated 0-13 volts
DISTORTION Less than 1% of the total output.
HUM LEVEL 0.1% of the maximum output.
PRICE: £98. Delivery Ex Stock.

MODEL OS 101

This new wide-range R.C. Oscillator provides a convenient voltage source at audio and supersonic frequencies for measuring the frequency characteristics of amplifiers, transformers, filters, wide band systems and for general laboratory use.

Features include constant output with change of frequency ● Low hum level ● Built-in attenuator ● Output monitored on direct reading meter ● Low distortion ● Vernier for high resetting accuracy ● Ability to change frequency rapidly ● High grade components for continuous rating ● 19 in. anodised dural panel ● Steel bench case in grey hammer finish.

Write for details of this and other high-quality instruments to:

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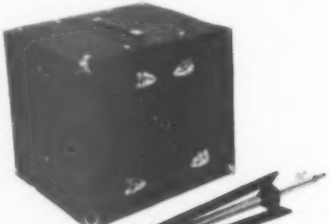
Sell or hire it to DANCE BANDS, YOUTH and SPORTS CLUBS, POLITICAL ORGANISATIONS, etc. (Specially useful for Whist Drives, Fetes, Carnivals, Firms' Socials, etc.)



The 'ENSA' Portable Amplifier

A.C./D.C. 200/250 v. Selected and used in quantity by E.N.S.A. after competitive tests, now further improved and supplied with the new Grampian D.P.2 Microphone, with on/off switch. The three substantially built wooden cases, covered with brown crocodile leather cloth, clip together to form one readily portable unit weighing only 44-lb and measuring 15in. x 15in. x 17½in.

List price complete with 2 speakers, microphone, leads and folding microphone stand. **£46.0.0**

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Telephone: Feltham 2657 *Telegrams: Reamp, Feltham*

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AC TP
AC VP1 5 pin
AC VP1 7 pin
AC VP2
AC2 HL
AC2 Pen
AC5 PenDD
AC6 Pen
AC6 Pen
AC6 PenDD
AZ1
AZ31
B36
B65
C1
C1C
CBL1
C CL31
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CL33
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D1
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D42
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D77
D155
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PM22D
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VP4 7 pin
VP4A 7 pin
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W21 7 pin
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"DEMOBBED VALVES"
MANUAL
giving equivalents of British and American Service and Civil Reference of Commercial types with an appendix
2/3
of B.V.A. Equivalents and comprehensive Price List. We have still many valves left at OLD-BUDGET rates which are actually sold at the old price

ADDITIONAL OR NEW TYPE VALVES
G13B/LB
GDO Germanium Diode
CG6M Crystal Rectifiers
UBL21/N
6H7
VR75/30
N150
W142
6BS8 Tenner
U282
7475
HL8
WL83
5D6
DA30
1R21
KF33
X18
L63D
6AB5

METAL RECTIFIERS
RM1
RM2
RM3
DRM1B
DRM2B
SB2 Centercode
SB3 Centercode

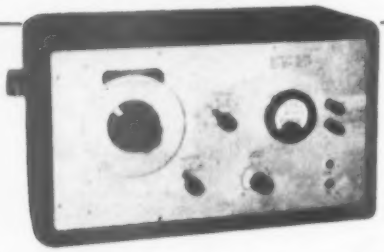
CATHODE RAY TUBES
C9A Br
C9B "
C12B "
C12D "
C14B "
C17B "
CRM91 Blue
CRM92A "
CRM121A "
CRM121B "
CRM122 "
CRM123 "
CRM151 "
MW6-2 Mag
MW22-16 "
MW22-17 "
MW22-18 "
MW31-16 "
MW31-17 "
MW31-18 "
MW36-22 "
MW41-1 "
6504A GEC
6905A "
6705A "
6704A "
6706A "
T9-A Fay
T12/44 "
T12/54 "
64K-2 Cos
7BP1 "
8AB "
5/2B Mar
TA10 "
TA10-J "
TA15 "
TA15-J "
12EP4 Emiscope
108K "

[Kindly mark envelope WW11]

AUDIO FREQUENCY SIGNAL GENERATOR

available now

BPL



Designed as a standard generator of calibrated audio frequency voltages covering a wide range of both frequency and voltage. The oscillator consists of a two-valve phase shift oscillator in which the frequency is varied by a change of the two resistance components of the Wien Bridge. The calibration of the oscillator is a direct reading on a 6in. diameter scale over an arc of 300°. By means of a multiplier, the entire frequency range of the instrument becomes direct reading, no compensating controls being required.

There is a fully automatic feed-back control effected by an electronic valve circuit. Thus the oscillator is continuously maintained on the verge of oscillation, producing a current with a minimum amount of distortion and constant output level.

FREQUENCY RANGE, 50 cycles to 55,000 cycles. Accuracy of ± 1½ per cent. or 0.5 cycle. Frequency drift less than 0.1 per cent. after 10 minutes' working. Other models have range of 30 cycles to 33,000 cycles, 10 cycles to 11,000 cycles, and 1 cycle to 22,000 cycles.

OUTPUT VOLTAGE, 15 volts R.M.S. maximum into 600 ohms. Basic range 0-15 volts. Less than 2 per cent. total harmonic distortion at maximum output for frequencies higher than 50 cycles.

DIMENSIONS AND FINISH, 19in. x 10½in. x 10in. (deep). Front panel anodised aluminium. Dust cover or cabinet consists of zinc-plated steel finished in black crinkle lacquer.

ALSO SUPPLIED
B.P.L. Super Rangers and D.C. Test Sets

LONDON STOCKIST
M.R. Supplies Ltd.
68 New Oxford St. W.C.1

BRITISH PHYSICAL LABORATORIES

HOUSEBOAT WORKS · RADLETT · HERTS · Telephone: RADlett 5674-5-6

The Latest **"CLIFTON" 1952**

Incorporating

- Magic Eye Volume Indicator
- Speeds: 15 in.—7½ in.—3¾ in. per sec.
- Playing Time: 17—34—68 mins.
- Response—50 to 10,000 cycles

Price **£55-10-0**

Exclusive of Tape or Microphone

Enquiries: Trade and Retail to :—

Sole Distributors: **WILL DAY LTD.**

19 LISLE STREET, LONDON, W.C.2
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Manufacturers: Bristol Magnetic Tape Recorders, Ltd.
11 Alma Road, Bristol 36088

Come to Classic for "The Classic Service"

TELEVISION RECEIVERS, TUBES & ACCESSORIES

Item No.		Cash	or Deposit	and 12 p'ments
125.	Teleman Wall Projection TV	£125 0 0	£45 0 0	153/4
		or 18 monthly p'ments of		10/6
126.	Decca Wall Projection TV	£158 0 0	£58 0 0	191/8
		or 18 monthly p'ments of		13/4
127.	Decca Wall Projection TV	£350 0 0	£125 0 0	452/6
		or 18 monthly p'ments of		32/6
128.	Rainbow Wall Projection TV	£175 0 0	£60 0 0	220/-
		or 18 monthly p'ments of		16/6
129.	Pye 16" Direct Viewing	£130 0 0	£45 0 0	160/-
		or 18 monthly p'ments of		11/-
130.	Peto Scott 16" Direct Viewing	£128 0 0	£44 0 0	160/-
		or 18 monthly p'ments of		11/-
131.	Ferguson 16" Direct Viewing	£110 5 0	£38 15 0	140/-
		or 18 monthly p'ments of		9/6
132.	Armstrong 12" Chassis	£53 0 0	£17 13 4	68/4
133.	Viewmaster Stages 1, 2 & 3	£10 7 8	£3 9 8	14/6
134.	Viewmaster Stage 5	£10 7 10	£3 10 0	14/-
135.	Viewmaster Stages 4, 6 & 7	£11 3 0	£4 0 0	15/3
136.	Viewmaster Components	£32 0 0	£10 0 0	45/-
137.	Viewmaster Set of Valves	£8 8 0	£3 0 0	11/6
138.	Viewmaster 9" Tallon Table Cabinet	66 3 9	£22 3 9	10/-
139.	Viewmaster 9" Tallon Console Cabinet	£13 15 0	£3 15 0	20/-
140.	Viewmaster 12" Tallon Table Cabinet	£7 14 0	£2 14 0	11/8
141.	Viewmaster 12" Tallon Console Cabinet	£13 15 0	£3 15 0	20/-
142.	Viewmaster 12" Ashdown Cabt., with doors	£13 10 0	£3 10 0	20/-
143.	Viewmaster 12" Classic Cabt., with doors	£15 0 0	£5 0 0	20/-
144.	Philips Projection Unit	£37 10 0	£12 12 0	46/4
145.	Allen Wide Angle Scanning Components	£6 8 0	£2 3 0	10/6
146.	Mazda, Mullard, GEC, etc., 9" Tubes	£13 13 6	£4 15 0	18/2
147.	Mazda, Mullard, GEC, etc., 12" Tubes	£18 4 10	£6 9 0	23/6
148.	Mullard 17" Tube	£24 6 5	£8 6 6	31/-
149.	English Elect. 17" Metal Tube 901	£24 6 5	£8 6 6	31/-
150.	TELE-KING 16" T/V Instruction Booklet	6 6	—	—

Full range of Antialite & Belling Lee aerials available from stock for Cash or H.P.

See our full page advertisemen opposite for further details.

The Classic Electrical Co. Ltd.,
"THE HI-FI TELEVISION SPECIALISTS"
353 384, LOWER ADDISCOMBE ROAD, CROYDON, SURREY.
TELE: ADDISCOMBE 6061/6062.

"CURRENT RELEASE"

150 "SOUND" REASONS TO

Come to Classic for "The Classic Service"

QUALITY AMPLIFIERS • SPEAKERS • RADIO FEEDER UNITS • MOTORS AND AUTO-CHANGERS • PICKUPS • TAPE AND DISC RECORDING AND REPRODUCING EQUIPMENT • HI-FI AND BIG SCREEN TELEVISION RECEIVERS.

WE HAVE THE FOLLOWING 150 QUALITY ITEMS AVAILABLE FROM STOCK

RADIO FEEDERS, AMPLIFIERS & TONE CONTROL UNITS

Item No.		Cash	or Deposit	and 12 p'ments
1.	Leak T12 with Control Unit	£37 16 0	£10 12 0	48/4
2.	Leak Feeder Radio Unit	£37 16 0	£10 12 0	48/4
3.	Leak Vari-slope	£12 12 0	£4 4 0	17/6
4.	Quad Amplifier	£35 0 0	£10 0 0	44/2
5.	Quad Radio Feeder Unit	£24 10 0	£6 10 0	29/4
6.	Sound Sales AZ Amplifier	£32 10 0	£10 10 0	39/4
7.	Rogers R.D. Minor	£11 0 0	£4 0 0	15/-
8.	Rogers Baby de luxe Amplifier	£21 0 0	£7 0 0	29/6
9.	Decca Type No. P.A.5	£17 10 0	£6 10 0	21/8
10.	Decca Type No. P.A.6	£26 5 0	£8 5 0	33/-
11.	Goodsell Amplifier 8A.10	£15 15 0	£4 0 0	20/4
12.	Goodsell Control Unit U/TC	£8 8 0	£3 3 0	12/6
13.	Goodsell Control Unit F/U/1C	£12 12 0	£4 4 0	17/6
14.	Goodsell MA15 Amplifier	£19 19 0	£6 10 0	25/6
15.	Goodsell Williamson UW18 Amplifier	£23 5 0	£10 10 0	30/4
16.	Goodsell Control Unit F/FA	£22 10 0	£7 10 0	29/0

MOTORS & AUTOCHANGERS

Item No.		Cash	or Deposit	and 12 p'ments
17.	Garrard RC.72A Unit with Head	£16 16 6	£5 16 6	21/8
18.	Garrard RC.75A	£17 17 0	£6 10 0	22/6
19.	Garrard RC.80**	£19 19 0	£6 15 0	25/4
20.	Garrard Transcription Motor 201*	£23 13 0	£8 0 0	29/2
21.	Garrard Transcription Motor 201/B*	£23 13 0	£8 0 0	29/2
22.	Garrard Transcription Motor 201/B**	£24 12 6	£9 0 0	29/2
23.	Connoisseur 2-speed Motor & Turntable	£22 16 0	£8 0 0	28/2
24.	Connoisseur 3-speed**	£22 16 0	£8 0 0	28/2
25.	Decca GU4 Unit	£9 19 11	£3 10 0	14/-
26.	Decca GU4A Acos Heads	£11 17 6	£4 5 0	16/6
27.	Decca GU4M Decca Heads	£13 10 0	£5 0 0	18/6
28.	B.S.R. MU10 Motors & Turntable	£5 18 7	£1 8 8	7/8
29.	B.S.R. MU14 Motors & Turntable	£6 8 6	£2 2 0	10/6
30.	B.S.R. GU4 Motors & Turntable	£12 19 0	£5 0 0	18/6
31.	Collaro 3-speed Auto 7", 10", 12"	£12 5 0	£5 0 0	16/6
32.	Collaro 3-speed Mixer 7", 10", 12"	£14 10 0	£5 0 0	20/-
33.	Plessey 3-speed Auto 7", 10", 12"	£18 18 0	£8 6 0	26/6
34.	B.S.R. Monarch 7", 10", 12"	£17 17 0	£8 0 0	26/6
35.	Chancery 331/3 Attachment	£3 15 0	£1 5 0	5/-
36.	Trixette A356 3-speed Garrard	£42 0 0	£14 0 0	53/4
37.	Decca Decalian 2-speed S/p.	£32 0 0	£12 0 0	40/-

* Limited Stocks.
** Orders accepted for early delivery.

LOUDSPEAKERS

Item No.		Cash	or Deposit	and 12 p'ments
38.	Goodmans Audiom 60*	£8 5 0	£3 5 0	12/6
39.	Goodmans Axiom 150 Mk. I*	£10 5 0	£3 10 0	15/-
40.	Goodmans Axiom 150 Mk. II	£14 9 0	£4 9 0	20/-
41.	Tannoy Due Concentric*	£27 10 0	£9 0 0	35/-
42.	Decca Corner Speaker	£31 0 0	£10 6 8	40/-
43.	Wharfedale Super 5/CS/AL	£7 4 4	£2 4 4	13/4
44.	Wharfedale Super 8/CS/AL	£7 4 4	£2 4 4	13/4
45.	Wharfedale OMMI Direc. 3-unit	£35 10 0	£28 12 0	90/9
46.	Wharfedale 10" Golden	£8 6 0	£2 16 0	13/4
47.	Wharfedale 10" CSB*	£16 10 0	£6 3 4	25/6
48.	Wharfedale W/12/CS*	£9 9 0	£3 3 0	14/-
49.	Wharfedale W12/CS/AL	£12 12 0	£4 4 0	17/4
50.	Wharfedale W10/CS	£16 0 0	£5 10 0	21/8
51.	WB Stentorian 12" unit*	£9 9 0	£3 3 0	14/-
52.	Rola G.12 units*	£9 9 0	£3 3 0	14/-
53.	Classic "Concert" 2-unit*	£45 10 0	£15 0 0	56/6
54.	Acoustical Corner Ribbon*	£90 0 0	£30 0 0	116/6
55.	Vitavox "Klipschorn"*	£145 0 0	£50 0 0	180/-
56.	Chadley Reflex Cabinet*	£10 10 0	£3 10 0	15/-
57.	Chadley Corner Cabinet*	£15 15 0	£5 5 0	21/-
58.	Classic Hi-Fi Cabinet for Quad Leak Amp.	£30 0 0	£10 0 0	40/-
59.	Voigt unit only*	£42 0 0	£14 0 0	53/4
60.	Voigt Corner Horn (White)*	£48 0 0	£16 0 0	60/-
61.	Voigt Corner Horn (Veneer)	£60 0 0	£20 0 0	76/8

* Items limited stock. Free Purchase Tax.

TAPE DESKS & TAPE RECORDERS

Item No.		Cash	or Deposit	and 12 p'ments
62.	Wearite Type A Tape Deck	£35 0 0	£12 0 0	45/-
63.	Wearite Type B Tape Deck	£40 0 0	£13 6 8	50/-
64.	Bradmatic Desk 6RP Heads	£42 0 0	£14 0 0	53/-
65.	Sound Mirror Type A	£23 0 0	£11 0 0	41/8
66.	Truvox Type A	£23 2 0	£8 0 0	30/2
67.	Lane Type 1	£16 10 0	£5 10 0	22/-
68.	Qualitape Type 1	£16 16 0	£5 17 0	23/-
69.	Excel Pre-Tape Desk	£75 0 0	£25 0 0	97/1
70.	MAS Type PM R1 Recorder	£150 0 0	£50 0 0	191/8
71.	Ferrograph Type A	£79 10 0	£26 10 0	100/-
72.	Ferrograph Type B	£99 0 0	£33 0 0	126/6
73.	Cliff Portable Recorder	£119 0 0	£40 0 0	152/6
74.	Sound Mirror Portable	£79 10 0	£26 10 0	100/-
75.	Sound Mirror Table Model	£99 10 0	£33 10 0	126/2
76.	Simon Mode 12B	£90 0 0	£30 0 0	76/8
77.	Simon Model 1A	£83 0 0	£27 13 8	105/-
78.	Wirek Magnograph	£85 0 0	£28 0 0	76/8
79.	Wirek Reporter	£58 0 0	£20 0 0	72/-
80.	Bradmatic Amplifiers	£92 0 0	£31 0 0	73/7
81.	Scophony Baird Mk. 2	£99 5 0	£33 15 0	83/3

TAPE RECORDING ACCESSORIES & EQUIPMENT

Item No.		Cash Price
82.	Bradmatic Circuits	5 0
83.	Bradmatic Plate Coil	9 0
84.	Bradmatic Oscillator Coil	9 0
85.	Bradmatic Bias Rejector Unit	12 6
86.	Bradmatic Mumetal Screens	4 6
87.	Bradmatic Tape Guides	4 6
88.	Bradmatic 5RP Heads	£3 5 0
89.	Bradmatic 6RP Heads	£3 15 0
90.	Bradmatic 5E Erase Heads	£3 5 0
91.	Sound Mirror Tape, per reel	£1 5 0
92.	G.E.C. Tape, per reel	£1 5 0
93.	EMI Tape, per reel	£1 10 0
94.	Scotch Boy Tape, per reel	£1 15 0
95.	Collaro Tape Rec. Motors*	£1 19 0
96.	Spare Spools	6 6
97.	Acos Microphone	£6 0 0
98.	Rothermel Mike	£3 0 0
99.	Reslo Ribbon Mike	£9 9 0
100.	Reslo Table Stand	£2 12 0
101.	Reslo Moving Coil Mike	£5 5 0
102.	B.S.R. FP.16, 1,400 r.p.m.	£1 10 0
103.	B.S.R. SS.1, 2,750 r.p.m.	£1 12 0
104.	B.S.R. SS.2, 2,750 r.p.m.	£1 5 0

* Left and right drive.

PICKUPS & PICKUP HEADS & CROSS-OVER UNITS
(H.P Available over £10)

Item No.		Cash Price
105.	Decca X.M8 with two Heads	£7 0 0
106.	Decca Hi-Fi Mag. Pick up Head	£3 19 6
107.	Connoisseur Pickup	£6 9 0
108.	Connoisseur Pickup Head	£3 11 8
109.	Connoisseur Pickup Transformer	15 0
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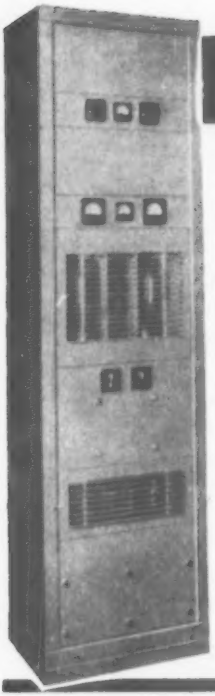

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THIS UNIT COMPARES MORE THAN FAVOURABLY WITH ANY OTHER MAKE OF TAPE RECORDER AT DOUBLE THE PRICE

THE 7 VALVE AMPLIFIER HAS BEEN SPECIALLY DESIGNED FOR HIGH QUALITY REPRODUCTION

Brief Specification :—

VALVE LINE-UP :—EF37A First Stage; 6SL7 Second Stage and Tone Control; 6V6 Output; 6X5 Rectifier; VT501 Bias and Erase Oscillator; 7193 Record Level Amplifier; 6U5 Magic Eye Record Level Indicator.

OUTPUT :—4 Watts. **FREQUENCY RANGE** :—50 c.p.s. to 9,000 c.p.s.

CONTROLS :—Volume; Record/Playback Switch; Treble Boost; Bass Boost—on/off.

A VISUAL MAGIC EYE Record Level Indicator is incorporated.

The unit is housed in a superbly finished rexine covered portable cabinet which incorporates a compartment for the Microphone when not in use. Weight complete 35 lb. Dimensions :—21in. long; 12½in. deep; 9½in. high.

This Recording Outfit has been designed for use with M.C.-1-111" SCOTCH BOY" Magnetic Tape. With this high quality tape a frequency range of 50 c.p.s. to 9,000 c.p.s. at tape speed of 7½in./sec. can be readily achieved. Additional reels of 1,200ft. can be supplied at 35/-.

39 GNS. Pkg. Carr. & Ins. 10/-

★ **SUPPLIED COMPLETE WITH MICROPHONE, REEL OF 'SCOTCH BOY' TAPE, AND REWIND SPOOL**

The Recorder Incorporates THE NEW LANE TAPE TABLE

Brief Specification :—

Made to high standards and incorporating features ensuring low level of "Wow" and "Flutter" throughout the full length of tape.

FAST REWIND. Provision for fast rewind and forward run in less than 1 min. in either direction. **THREE MOTORS** obviating friction drive.

HIGH FIDELITY RECORD PLAYBACK (1 HOUR APPROX. PLAYING). The Table is fitted with high fidelity record play-back head of new design owned to high impedance and a separate A.C. Erase Head. The Heads are built-in to allow easy access for playing from standard 1,200ft. Reel of Tape.

TAPE SPEED 7½in. sec.

For use on A.C. 200/250, 50 cycles mains only.

To those not wishing to purchase the complete Recorder, separate units are available as follows :

THE BUILT AMPLIFIER	PORTABLE CABINET	THE LANE TAPE TABLE	ROTHERMEL MICROPHONE
Complete with 8" Speaker			
£14 · 14 · 0	£4 · 19 · 6	£16 · 10 · 0	£2 · 19 · 6
Plus 7/6 Pkg. Carr. & Ins.	Plus 5/- Pkg. Carr. & Ins.	Plus 7/6 Pkg. Carr. & Ins.	Specification below

PREMIER TABLE MODEL MAGNETIC TAPE RECORDER

IN KIT FORM.—The Kit includes ALL parts, valves, cabinet, loud speaker, Reel of "Scotch Boy" Tape, Rewind Spool and The NEW Lane Tape Table already assembled but excluding Microphone.

SPECIFICATION AS PREVIOUSLY ADVERTISED **£29 : 8 : 0** (Packing and Carriage 15/-)

COMPLETE—to those unable to build this TAPE RECORDER, we offer it built, tested and ready to plug in, complete with Microphone, Reel of "Scotch Boy" Tape and Rewind Spool.

SPECIFICATION AS PREVIOUSLY ADVERTISED **£36 : 10 : 0** (Packing, Carr and Ins. 1 Gn.)

The NEW Microphone . . . for TAPE RECORDING - AMATEUR RADIO - PUBLIC ADDRESS

The 2156 CRYSTAL MICROPHONE made specially for Premier by one of the world's leading manufacturers of Microphones. Although giving better all-round performance than most Microphones, we are able to offer this Unit at less than half the price of any comparable Microphone of other makes.

Brief Specification :—

SENSITIVITY —minus 55 d.b. relative to 1 v./dyne/cm².

RESPONSE —essentially flat from 35-9,000 c.p.s., recommended load resistance 5 megohms for flat response at low frequencies.

DIMENSIONS—overall length 5¼in. Width 2¼in. at widest part of Ball Top, tapering to ¾in. at base of housing.

PRICE £2 : 19 : 6

The Microphone is unaffected by mechanical vibrations and low frequency wind noises. An attractive black all-metal housing provides complete screening and protection for the crystal insert. The crystal is virtually unbreakable and specially treated to minimise the effect of humidity. The modern design of the Unit enables it to be used as a Hand Microphone, with a Base as a Desk Microphone, or fixed to a Pedestal Floor stand. Screw fitting for any standard British type Stand.

Especially recommended for use with the PREMIER MAGNETIC TAPE RECORDER

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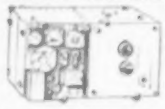
RADIO B. H. MORRIS & CO. (RADIO) LTD. TELEVISION

Please quote Dept. W.W.

TRANSMITTER RECEIVER TYPE TR9H



Consists of Transmitter Type T1336 and Receiver R1130, in one case. This is a 9-valve Battery operated Unit covering 1.5 Mcs. to 7.6 Mcs. Crystal controlled complete with valves but less crystal. 50/-, plus 2/6 packing and postage.

EX-R.A.F. TRANSMITTER T1154 SERIES

A versatile High Power(c) Transmitter for C.W., M.C.W. & Phone(c) Ranges 1945 Kcs., 3.5 Mcs. 3.95-6.0 Mcs. & 7 Mcs. Mechanism is arranged so that predetermined frequencies can be held or returned to. Complete with 4 valves—2-PT15 pentodes in parallel driven by an MLO (a screened Hartley oscillator) circuit. A further MLO valve provides a 1,200 cycle side tone to enable the operator to log his transmissions on C.W. Price 39 6, plus 10/- Pkg. & Carr.

12 v. POWER SUPPLY UNIT and L.F. AMPLIFIER

A 12v. vibrator power pack and amplifier combined. Unit contains 12 v. Mallory vibrator with filter condensers, 2 selection metal rectifiers, approximately 500 v. 30 mA, 1-ST12 valve, various chokes, transformers and a host of other useful components. Housed in a metal case measuring 11½in. wide, 9in. deep, 4in. high. Price 29 6, plus 5/- Pkg. & Carr.

POWER SUPPLY UNIT No. 7

Ref. ZA1181. A portable Unit for charging 6 volt Accumulators by hand. Designed for the W.S.11 could be used for many other purposes. Consists of a steel metal case, dims. 17½in. x 9½in., with detachable lid, containing hand driven generator with gear mechanism which delivers 6 volts D.C. at 4 amps. also 4 volt output and battery clamp. Price 32 6, plus 5/- post/pkg.

CAR BATTERIES—*BRAND NEW*

6 v. 11 plate—**PREMIER** Hght. 9½in. Lgth. 7½in. Depth. 5½in. Price 65/-.
6 v. 15 plate—**HEADING** Hght. 7½in. Lgth. 9in. Depth. 7in. Price 75/-.
6 v. 15 plate—**DELCO-KENT.** Hght. 7½in. Lgth. 9in. Depth. 7in. Price 97 6.
6 v. 23 plate—**DELCO-KENT** Hght. 9½in. Lgth. 13in. Depth. 7in. Price 110/-.
12 v. 9 plate—**PREMIER** Hght. 9½in. Lgth. 13in. Depth. 9½in. Price 110/-.

ALL PRICES PLUS 7/6 CARR. & PACKING

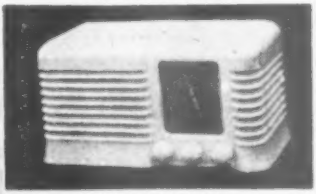
SMITH'S 8-DAY AIRCRAFT CLOCKS

Luminous dial can be supplied with trip hands as illustrated or with plain glass dome without trip hands. When ordering please specify type required. Housed in strong black Metal casing. Panel mounting. Dimensions: 4½in. dia. dial. Fixing Panel 2¾in. sq. Projection 4½in. from back. Price 37 6. Plus 1/6 post/pkg. ins.

MAINS NOISE ELIMINATOR KIT

Two specially designed chokes with three smoothing condensers with circuit diagram. Cuts out all mains noise. Can be assembled inside existing receiver. 6/- complete.

BUILD A PROFESSIONAL LOOKING RADIO AT LESS THAN HALF TO-DAY'S PRICE



We can supply all the parts to help you.	
Bakelite Cabinet (Brown or Ivory)	17 6
Packing and insurance	2 6
Punched Chassis, 3-valve plus rectifier T.R.F.	3 6
Engraved Glass Dials, 180x50 and some 200 m. With station names, new wavelength	— 1 6
T.R.F. Coils, 14-50 m., 50-2,000 metres, pair	6 6
Drum (2½in. Diam.)	1 6
Driving Cord	1 6
Double pointer	4d.
Spring	3d.
Nylon stud (rigid)	6d.
16mf Pencil Plate	2 6

SEND 1 6 FOR EASY TO FOLLOW POINT-TO-POINT DIAGRAMS AND CIRCUIT DIAGRAM which shows how YOU can build the Receiver Illustrated above.

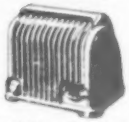
THE COMPLETE KIT

to construct a 3-valve plus rectifier T.R.F. Receiver for use on 200/250 v. A.C. mains can be supplied at £6 9 6, plus 2/6 packing and carriage.

Each kit is complete in every detail, nothing has to be made or improvised. Easy to follow, point-to-point diagrams are supplied, making construction very simple. The dial is illuminated and the Receiver housed in a Bakelite Cabinet size 12½in. x 8in. x 7in., presents an attractive appearance. The valve lineup is: 7B7A—H.F. Pentode. 7B11—Detector. APT1—Output and Metal Rectifier.

Wavebands coverage is for the medium and long bands. Choice of Walnut or Ivory coloured Cabinet.

PREMIER'S MOST SENSATIONAL OFFER
THE FAMOUS **'SOBELL'** **4 VALVE SUPERHET TABLE RECEIVER**



M. & L. WAVEBANDS

Valve Lineup 1d5, 3s1s, 1a6, 2s2s.

Entirely transportable and unusually sensitive owing to special feed-back circuit employed. Housed in attractive plastic cabinet.

Choice of 5 Colours—Walnut, Pastel Peach, Ivy Blue, Arctic Green, Magnolia. Carrying handle incorporated in design. For use on A.C./D.C. mains.

£8.19.6 Plus 3/- Pkg. Carr. Ins.

Covered fully by Manufacturer's Guarantee

HEADPHONES

Balanced Armature Low Resistance
Type 5 11 each. Type 6 11 each.
High Resistance 12 6 pair
Lightweight High Resistance 14 6 pair.

ACCUMULATORS

By world-famous maker. 2 volt 10 amp 4 11

CRYSTAL MICROPHONE

An eminently good class crystal microphone which can be safely used on A.C./D.C. amplifiers. High impedance. No background noise, really natural one. The ideal Mike for tape, wire and disc recording and sound projectors. Price 22 6.

BATTERY CHARGER KITS

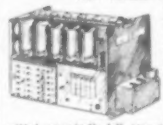
All incorporate metal rectifiers. Transformers are suitable for 200/250 v. A.C. 50 cycle mains.

Cat. No.		
2002	Charges 6 volt accumulator at 1 amp. Resistance supplied to charge 2 v. accumulator	£1 2 6
2003	Charges 12 volt accumulator at 1 amp.	£1 7 6

A WORLD-FAMOUS *Manufacturer's Surplus of* **RADIO RECEIVER CHASSIS 7-valve RECEIVER**

Built to exacting specifications and incorporating features ensuring superlative tonal qualities and world-wide reception. Specification: 8 watts push-pull output using 2 Mazda Pen. 45 Valves. Ample negative feedback is applied over all the audio-amplifier. Amplifier Mazda Type BL41DD gives signal injection. A.V.C. and Phase Splitting. Two stages of I.F. amplification 465 Kcs. using Mazda 6P61. **FOUR WAVEBANDS—14 M.-24 M., 24 M.-55 M., 190 M.-600 M., 800 M.-2,000 M.** DIRECT and VERNIER TUNING. Gram. position on switch. Provision for external Loudspeaker. For use on 200/250 A.C. Mains. £13 10/-, plus 2/- pkg. and carr.

1124 RECEIVER UNIT



Range 30 to 40 Mcs. Contains six new Valves 3 SH7, 1-SH2, 1-1A5 GT, 2 frequency changers, 1-4311 24 ceramic trimmers, 6 ceramic valve-holders, 6 valve screening case, 30 resistors, 3 potentiometers, mica and tubular condensers, ceramic coil formers 5-way 4 bank switch with long spindle I.F. transformers, etc. Brand new in maker's carton at 22 6, plus 2/6 pkg.

+ *BRAND NEW* **R1155 RECEIVERS**

In original cases, complete with 10 valves. Frequency range 18.5 Mcs./75 Kcs. in 5 wavebands. £11 19 6. 10/6 packing and carriage.

POWER SUPPLY UNIT

for above, incorporating output stage. Supplies an output of 250 volts at 80 mA., which is ample for the R1155 with the output stage. Jones plugs for connecting the Power Pack to the Receiver are included. The 6V6 output valve complete with Output Transformer and 9/10 chassis is built into the unit. Price £5 5/-, plus 5/- packing and carriage.

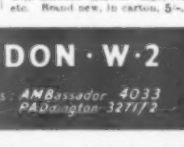
As a special offer, power supply unit including speaker together with R1155 receiver.
PRICE **£16.19.6.** *Plus 15/- pkg. & carr.*

★ *We now have available a small quantity of used R1155 Receivers. We can offer these at the ridiculously low price of £9 19 6, plus 10/- Pkg., Carr., Ins. These Receivers have been reconditioned and Air Tested and are fully guaranteed to be in perfect working order.*

BRAND NEW **R1355 RECEIVERS**

As specified for the Inexpensive Television, complete with 11 valves. 39 6, plus 7/6 packing and carriage.

0-1 mA METER IN PLASTIC CASE. The movement is 0-1 mA mounted in a case 3½in. square and 3½in. high. The scale is 2½in. long and the dial is 2½in. diameter. There is ample room in the case for a switch, and multipliers. Internal Resistance 100 ohms. Price 27 6.



2 STAGE QUALITY AMPLIFIER
Complete with 10in. Enerrised LOUDSPEAKER
4 watts output. A.C. 110/250v. mains.
£6.19.6
plus 5/- carriage.

EX-U.S.A. U.H.F. AERIAL

with untuned detector stage, consisting of V.R.92 valve etc. Brand new, in cartons, 5/-.

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TERMS OF BUSINESS: Cash with order or C.O.D. over £1. Please add 1/- for Post Orders under 10/-, 1/6 under 40/- unless otherwise stated.

Telephones: ANBassador 4033 PADdington 3271/2

OPEN UNTIL 6PM ON SATURDAYS

IMPORTANT ANNOUNCEMENT: WE CANNOT ACCEPT RESPONSIBILITY FOR, NOR CAN WE GUARANTEE ANY—

—TELEVISION, GRAMOPHONE AND SOUND RECORDING COMPONENTS

PREMIER RADIO Company

(REGD.) ESTAB. 40 YRS.

B. H. MORRIS & CO. (RADIO) LTD.

Please quote Dept. W.W.

RADIO

PREMIER MAINS TRANSFORMERS

All primaries are tapped for 200-230-250 v. mains 40-100 cycles. All primaries are screened. All L.T.'s are centre tapped.

SP175B, 175-0-175, 50 m/a., 4 v. @ 1 a. 4 v. @ 1-5 a.	25/-
SP200B, 250-0-250, 60 m/a., 4 v. @ 1-2 a. 4 v. @ 1-5 a.	25/-
SP200A, 300-0-300, 60 m/a., 6.3 v. @ 2-3 a. 5 v. @ 2 a.	25/-
SP200B, 300-0-300, 60 m/a., 4 v. @ 2-3 a. 4 v. @ 1-5 a. 4 v. @ 1-2 a.	25/-
SP201A, 300-0-300, 120 m/a., 5 v. @ 2-3 a. 6.3 v. @ 3-4 a.	29/-
SP201B, 300-0-300, 120 m/a., 4 v. @ 2-3 a. 4 v. @ 2-4 a. 4 v. @ 1-5 a.	28/-
SP250A, 250-0-250, 100 m/a., 5 v. @ 2-3 a. 6.3 v. @ 2-3 a.	29/-
SP250B, 350-0-350, 100 m/a., 4 v. @ 2-3 a. 4 v. @ 2-3 a. 4 v. @ 1-5 a.	29/-
SP251, 350-0-350, 150 m/a., 4 v. @ 1-2 a. 4 v. @ 2-3 a. 4 v. @ 3-6 a.	36/-
SP275A, 375-0-375, 250 m/a., 6.3 v. @ 2-3 a. 6.3 v. @ 3-5 a. 5 v. @ 2-3 a.	39/6
SP275B, 375-0-375, 250 m/a., 4 v. @ 2-3 a. 4 v. @ 2-3 a. 4 v. @ 3-6 a.	39/6
SP425B, 425-0-425, 200 m/a., 4 v. @ 2-3 a. 4 v. @ 2-3 a. 4 v. @ 3-6 a. 4 v. @ 2-3 a.	42/6
SP501, 500-0-500, 150 m/a., 4 v. @ 2-3 a. 4 v. @ 2-3 a. 4 v. @ 2-3 a. 4 v. @ 3-5 a.	47/-
SP501A, 500-0-500, 150 m/a., 5 v. @ 2-3 a. 6.3 v. @ 2-3 a. 6.3 v. @ 2-3 a.	50/-
SP425A, 425-0-425, 200 m/a., 6.3 v. @ 2-3 a. 6.3 v. @ 3-6 a. 5 v. @ 2-3 a.	52/6

PREMIER VARIABLE IMPEDANCE "MATCHMAKER" MO.15 OUTPUT TRANSFORMER

Designed to meet the demand for an efficient variable ratio Output Transformer. 11 ratios from 12 : 1 to 90 : 1 all centre-tapped and can be used to match any output valves either single or push-pull Class "A," "AB1," "AB2" or "B" to any low impedance speech coil or condensation thereof. Primary Inductance 60 henries. 12 watts audio 100 m/a. Price 45/-.

WILLIAMSON AMPLIFIER TRANSFORMERS (To designers specification)

The Output Transformer 7/8 watts acc. £4 4/-.
The Mains Transformer PREMIER RP425A, £2 12/6

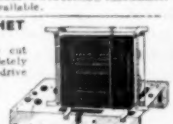
SPECIAL OFFER DOUBLE WOUND AUTO TRANSFORMER 250 watts.

Input/Output	Output/Input
100 volts	110 volts
110 "	115 "
200 "	110 "
210 "	110 "
220 "	122 "
230 "	134 "
240 "	146 "
250 "	

Price 50/-. Plus 2/6 Pkg. Carr.

With the two windings connected in series a vast number of voltage tappings are available.

7-VALVE SUPERHET CHASSIS



All control mountings cut out, fitted with completely assembled full vision drive scale, long, medium and short wavebands and band spread. Heavy flywheel tuning. 19/6, plus 2/6 pkg. and carr.

H.T. ELIMINATOR AND TRICKLE CHARGER KIT

All parts to construct an eliminator to give an output of 120 volts at 20 m.A., and 2 volts to charge an accumulator. Uses metal rectifier. £2.

WHITE RUBBER MASKS

Per 6in. Tube, 8/6.

MAGNETIC MARCHING COMPASS

Luminous Dial, enclosed in black bakelite case. Size 3in. × 2¼in. × 7⅛in. Price 18/6.

TELEVISION

THE COLLARO 3RC511 3-SPEED AUTOMATIC RECORD CHANGER

A new large purchase enables us to offer these fine Motor Units at NEW LOW PRICES which are approximately 25% off the normal list prices. Designed for single-fix and reliability at low cost. The Pick-up can be moved to any position whilst the machine is stationary or mixed without interfering with the mechanism. It is impossible to lose the mechanism and it should never go out of adjustment. The machine will play either 9-10in. or 7-12in. records not intermixed. The Motor is suitable only for A.C. supplies of 100/125 volts or 200/250 volts at a frequency of 50 cycles per second. The unit is supplied complete with the latest plug-in type Dual purpose Crystal Head, fitted with a Permanent Sapphire Stylus, and is suitable for use with either long-playing or standard recordings. All Pick-ups are fitted with a twin half-way Pickup base thus ensuring perfect freedom of movement. The Motor Plate is finished throughout in a special hammer finish and is virtually scratch proof. The complete Unit occupies a space 15in. × 12¼in. 4¾in. above the Motor Board and 2¼in. below.

PRICE **£11 : 11 : 0** Including Purchase Tax.
Plus 5/- Pkg./Carr./Ins.

GARRARD ELECTRIC 'GRAM MOTOR

Induction Motor, 100-250 volts, 50 cycles A.C. only. The GARRARD Induction Motor is totally enclosed. Entirely free from mains-frequency disturbance, magnetic hum and electrostatic. Variable speeds. With 12in. Turntable. Price £4 19/6 plus packing and carriage 5/-.

THE NEW BSR "MONARCH" AUTO-CHANGER

This is a 3-speed automatic mixer record changer designed to play 12in., 10in. and 7in. records intermixed in any order. Capacity 10 records, operates on 100/125—200/250 volts 50 c/s. A.C.

New reversible dual stylus crystal pick-up has extended frequency range to 10,000 c.p.s. Self-compensated for the L.P. bass frequencies with the Turnover frequency at the correct point. PRICE £17 17/-, plus 5/- packing, carriage and insurance.

AVAILABLE ONCE AGAIN!

A.C.R. 1 C.R. TUBES

(DIRECT REPLACEMENT FOR A.C.R. 2X)

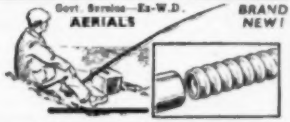
5in. screen. 4 volt Heater. This Elstree tube is recommended as eminently suitable for Television. 15/- plus 2/6 Pkg. Carr. and Ins. Data sheet supplied

V.C.R. 97 C.R. TUBES

We are once again able to offer this famous tube with the usual PREMIER guarantee of a full screen picture free from cut-off. Every tube is television picture tested before despatch. £2 5/- post paid.

Govt. Surplus—Ex-W.D. BRAND NEW!

AERIALS



12ft.—3 4ft. screw-in sections of copper-plated steel highly flexible with monolith screw fix. Locating fix. to 4in. Brand new in container. 6/6. Also plug-in type 4/6. Packing and carriage 1/6. Insulated Base 2/-. Welding waterproof carrying case with shoulder sling. 2/6. Please specify make when ordering.

CORRECT ASPECT WHITE RUBBER MASKS

For 12in. Round or Flat-faced Tube 16/11

SUPER QUALITY TELEVISION MAGNIFYING LENS

To suit 9in., 10in. or 7in. Tubes. Increases picture size considerably. 25/- each.

METERS

Large stocks available a few of which are enumerated below :—

Full Scale Deflection	Scale Length	External Dimensions		Movement	
	Ins.	Ins.			
5A	1½	2¾ × 2¾		R.F. Thermo	7/6
2A	1½	2¾ × 2¾		M/C	6/6
2.5A	1½	2¾ × 2¾		R.F. Thermo	7/6
3A	1½	2¾ round		R.F. Thermo	7/6
3.5A	1½	2¾ × 2¾		R.F. Thermo	7/6
1A	1½	2¾ × 2¾		R.F. Thermo	7/6
5A	2	3¼ round		Centre Zero	10/6
8A	1½	2¾ × 2¾		M/C	12/6
20A	1½	2¾ round		M/C	8/6
30A	1½	2¾ × 2¾		M/C	8/6
40A	1½	2¾ round		M/C	9/6
1.5M/A	1½	2¾ round			12/6
2M/A	1½	2¾ × 2¾		M/C	8/6
5M/A	1½	2¾ × 2¾		M/C	8/6
6M/A	2	3¼ round			16/9
50M/A	1½	2¾ × 2¾		M/C	8/6
100M/A	1½	2¾ × 2¾		M/C	8/6
1mM/A	1½	2¾ round		M/C	12/6
500 Microa.	1½	2¾ round		M/C	15/-
20V	2	3¼ round		M/C	9/6
40V	1½	2¾ × 2¾		M/C	8/6
1M/A	2	3¼ round		M/C	25/-

MOVING COIL METER

A super-quality Moving Coil Meter basic movement 2 m.A. Scale dimension 3¼in. Overall dimensions 2¾in. dia. 1¼in. deep. Bakelite Case projecting type. At present scaled 1 amp. R.F. for removing thermo-couple, reversing scale and re-calibrating the meter a high grade test instrument with any range above the basic F.S.D. may be built up. Price 4/9.

RADIO CABINET (WALNUT FINISH)

Outside dimensions 16½in. high, 10in. deep, 11½in. wide.

A beautifully made cabinet. £3 10/-, plus 7/6 carr. pkg.

5-VALVE SUPERHET RADIO CHASSIS

Drilled and cut out for all necessary control mountings and Mains Transformer, fitted with 5 Amphenol Octal Valveholders, Aerial, Earth and Gramophone Sockets. Set of Tuning Gang Coils (enser, full vision drive Tuning Assembly consisting of unbreakable Perspex Bevelled scale for long, medium and short wavebands. Calibrated in metres, kilocycles and station names, price 39/6.

AS A SPECIAL OFFER—CABINET ILLUSTRATED ABOVE AND CHASSIS, TOGETHER £5. 5. 0 Plus 7/6 Carr./Pkg. & Insurance.

THIS IS OUR ONLY ADDRESS

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TERMS OF BUSINESS: Cash with order or C.O.D. over £1. Please add 1/- for Post. Orders under 10/- 1/6 under 40/- unless otherwise stated.

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—KIT OR COMPONENT SOLD AS A PREMIER PRODUCT BY FIRMS OTHER THAN OURSELVES

MODERN ELECTRICS LTD.,

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Export enquiries welcomed. *Immediate delivery from stock.* *Prompt attention to post orders.*

TAPE RECORDERS

SOUNDMIRROR
Table Model £69 10 0
Portable £74 10 0

SCOPHONY-BAIRD
New Model Mk. 2, complete £68 5 0

SIMPHONIC
Model 28 ..... £63 0 0

REFLECTOGRAPH
Continuously Variable From 2in.-8in. per sec., separate Record and Play back Heads. Twin Track £93 0 0

RECORDING TAPE

SOUNDMIRROR
Paper Tape £1 5 0
Spare Spool 6 6
E.M.I. H.60, 1,200ft. £1 15 0
E.M.I. H.60, 600ft. £1 1 0
E.M.I. H.65, 1,200ft. £1 15 0
E.M.I. H.50, 1,200ft. £2 8 0

SCOTCH BOY
1,200ft. £1 15 0
SCOTCH BOY, 600ft. £1 1 0
Spare Spools, 1,200ft. 4 3
Spare Spools, 600ft. 3 9
E.M.I. H.57, 3,250ft. £6 0 0
"Magnetic Recording," by S. J. Begun £1 5 0

VALVES
We are one of London's Largest Stockists — Please write for requirements.

RECORD REPRODUCING EQUIPMENT

DECCA
2-speed Motors, complete with Turntable and Rubber Mat £3 18 6
3-speed, complete £6 8 6

B.S.R.
3-spd. (Crystal T/O Hds.) £9 19 11
3 spd. (with 2 GP20 Hds.) £11 16 6
3 spd. (with 2 Decca Hds.) £13 18 6
3 spd. Auto-Mixer £17 17 0

GARRARD
RC.75 (3-spd. Auto) £16 16 6

COLLARO
3RC511 (3 spd. Auto Dual Purpose Head) £15 10 6
3RC511 (3 spd. with 2 Hds.) £18 14 0
3RC521 (Auto-Mixer) £21 2 7

CONNOISSEUR
3 spd. Motors £23 13 0

SPEAKERS IN STOCK

GOODMANS
Axiom 150, Mk. 2 ..... £14 16 10
Audium 60 ..... £12 6 3

WHARFEDALE
W.12/CS £14 6 0
Golden 10C.S.B. £9 0 5
Super 8CS.AL £7 4 4
Bronze 10 ..... £3 9 6
Bronze 8 ..... £3 10 0

TEST GEAR

AVO
Model 8 ..... £23 10 0
Model 7 (latest) £19 10 0
Uniminor Mk 1.2 ..... £10 10 0
Universal Bridge £34 0 0
Wide Band Sig. Gen. £30 0 0
Valve Characteristic Meter £60 0 0
D.C. Minor £5 5 0
10 kV. Multiplier for Model 8 ..... £2 5 0
Carrying Cases for Models 7, 8 and 40 ..... £3 8 0

ADVANCE
H.1 (Sig. Gen.) £25 0 0
E.2 (Sig. Gen.) £28 0 0

PIFCO. Radiometer £1 9 6

COSSOR
Double Beam £93 10 0
Oscilloscope Single Beam £28 0 0

TAYLOR
ALL NEW TAYLOR TEST GEAR IN STOCK AND AVAILABLE ON H.P. Send S.A.E. for Catalogue and Terms.

PICK-UPS

ACOS
G.P.20 (Std. or L.P.) £3 11 5
Spare Heads for above £2 3 4

DECCA
XLT.O £3 19 2
XMS, Magnetic £7 0 0

CONNOISSEUR
Super Lightweight, LP.Std. £10 0 8
Spare Heads £3 11 8

LEAK PICK-UPS
Dynamic (Ruby Stylus) £12 0 8
Dynamic (Diamond Stylus) £18 8 4

MICROPHONES

ACOS
Mic 22 (Crystal) £6 6 0
Mic 22 (head only) £4 10 0
Mic Inserts for above £1 9 6
Mic 16 (Crystal) £12 12 0
Mic 30 (Crystal) £4 4 0

SOUNDMIRROR
M.C. with T.F. £7 7 0

LUSTRAPHONE
M.C. with T.F.C.51 ..... £5 15 6
M.C. less T.F.C.51 ..... £5 5 0
Heavy Table Base for above £1 1 0
Hand M.C. with T.F. CH.51 ..... £5 6 0
Hand M.C. less T.F. CH.51 ..... £5 15 6

RESLO M.C. (Low Imp.) £6 0 0
RIBBON £7 5 0

FLOOR STAND
(Microphone), 3 extensions £3 12 6

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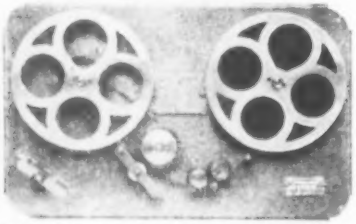

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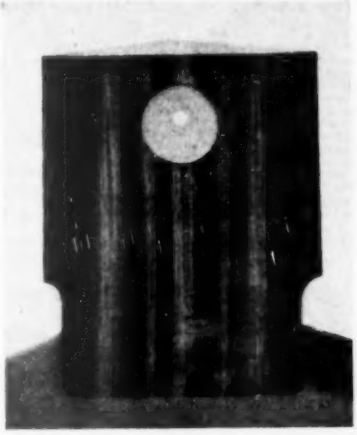

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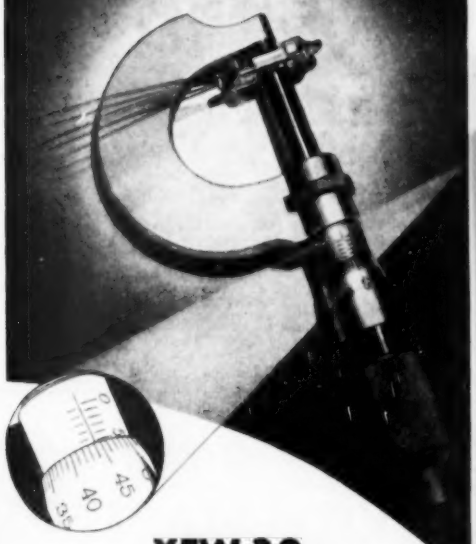

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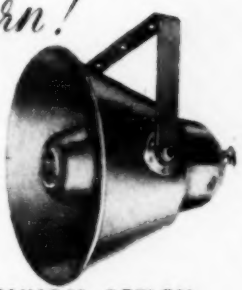

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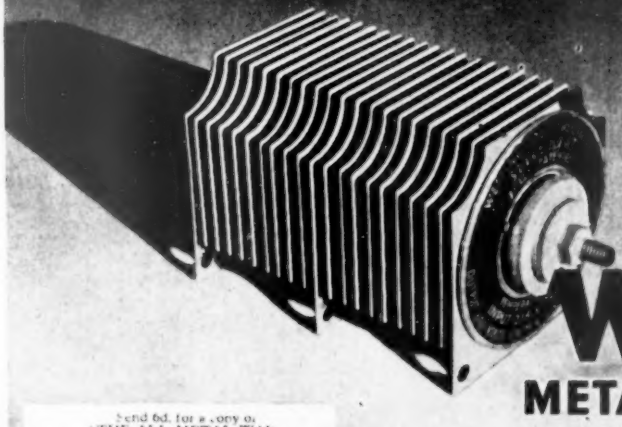

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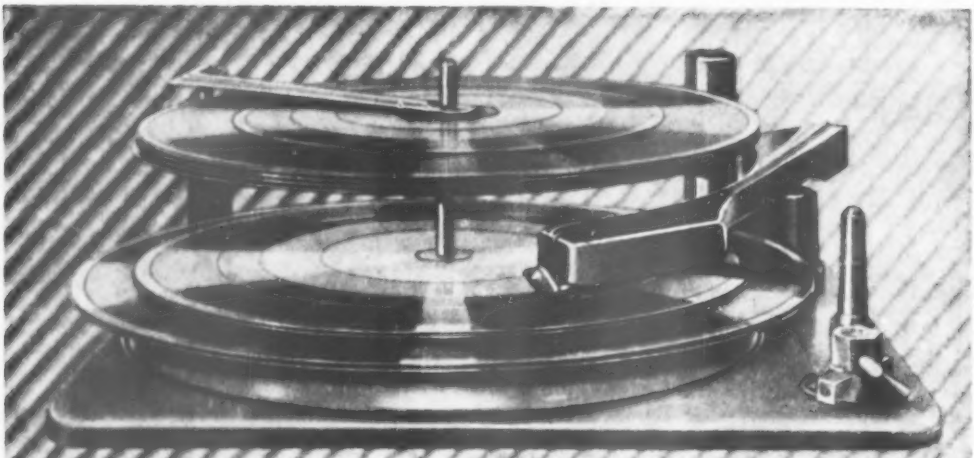

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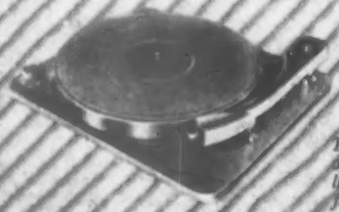

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Wireless World

RADIO, TELEVISION
AND ELECTRONICS

42nd YEAR OF PUBLICATION

Managing Editor : HUGH S. POCOCK, M.I.E.E.
Editor : H. F. SMITH

NOVEMBER 1952

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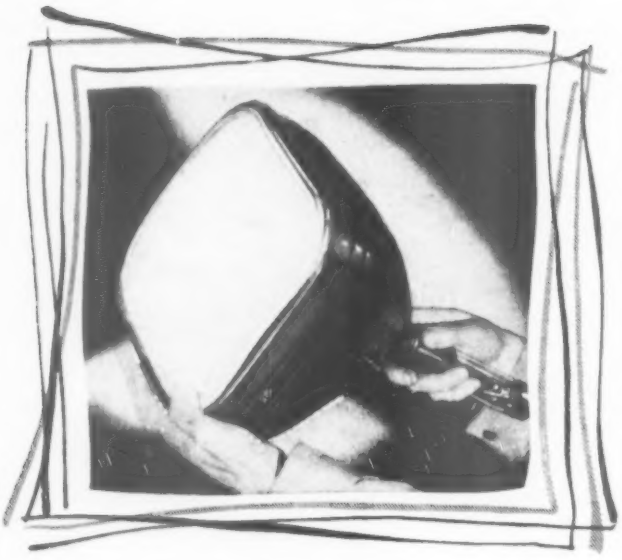
tube economy



the public is being offered increasingly favourable terms for television maintenance service. This is a very real tribute to those progressive dealers who have continually improved these schemes for the benefit of their customers.

the comparatively high value of the cathode ray tube has, of course, constituted a major problem in this connection. Nevertheless, this difficulty has been greatly alleviated by the longer life of Mullard tubes. Dealers have now had sufficient experience with Mullard Long Life Tubes to know that they can plan attractive maintenance schemes with confidence. This is one of the reasons for the growing popularity of the good sets which are fitted with these reliable tubes.

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Wireless World

NOVEMBER 1952 VOL. LVIII. No. 11

Revolution in Broadcasting

IN at least one respect the recently issued B.B.C. Report* is a disappointing document. As the period with which it deals ended in March, 1952, there is no comment on the terms of the new Charter, the official views on which should make interesting reading. The opening part of the Report will arouse some sympathy with the Corporation, which of late has suffered from having too many masters. Prolonged uncertainty as to its fate must have brought about an unenviable feeling of frustration, but, in spite of all these troubles, there is solid progress to go on record, particularly in the television service.

Naturally enough, most of the Report deals with programme and administrative matters which are not our main concern. To us the most interesting part is that dealing with the future of the sound service. Great emphasis is laid on the fact that, so far as British broadcasting is concerned, long and medium waves have had their day. The position on these wavelengths has long been unsatisfactory, and is deteriorating; the only hope of improvement lies in the use of metre waves to augment, and ultimately to replace the present system. The Report goes so far as to admit that, during the winter, the B.B.C. was forced, in an attempt to reduce the jamming trouble, to make "technical adjustments" (presumably over-modulation) to all high-power stations. Some improvement in signal strength was produced, but at the expense of "slight distortion during loud passages."

Problems of Waveband Changing

The suggested change of the present wavebands to metre-waves is, of course, a revolutionary one which poses all kinds of problems—technical, economic and political. The general idea of such a change was envisaged in the new B.B.C. Charter, which, indeed, specifically laid down that frequencies higher than 30 Mc/s were to be used for any stations needed to provide improved coverage of the country. But no detailed scheme for providing a national service has yet been made public, though the B.B.C. laid before the Government early last year a plan for a chain of v.h.f. frequency-modulated stations to cover almost the whole of the United Kingdom.

Before any change can be made, plans must be approved by the Postmaster-General, who in his turn must be advised by the Television Advisory Committee, which, as we reported recently, was to be reconstituted and strengthened to take under its wing the problems of v.h.f. sound broadcasting as well as television. Unfortunately, from the point of view of those who want to see something happen quickly in these spheres, the Television Advisory Committee seems likely to stand in need of reanimation as well as reconstitution; at the time of writing the Committee has held no meetings for over a year. When it does resume activities, the agenda looks like being a full one. According to the plan laid down by the Government, the T.A.C. must, after preparing a report on the recommended characteristics of v.h.f. sound broadcasting, turn to the even more controversial issue of sponsored broadcasting, and the conditions under which it should be licensed.

Broadcasting of the Future

Except for the fact that under present circumstances the T.A.C. is likely to be overloaded with work, *Wireless World* sees nothing wrong in the idea of a single advisory body dealing with both sound and vision. Though it would be indeed rash to speculate on the future of broadcasting, it seems likely that the two services may well be so closely merged that there will be no clear dividing line between them. But, if v.h.f. is to become the main, or perhaps the only, vehicle for sound, the anomalously named T.A.C. will assume an importance much beyond its present standing and will become the body to advise the Government on all broadcasting problems. In a sense, it will become another of the B.B.C.'s masters, of which, as we have said, there are already too many. The new director-general of the Corporation, Sir Ian Jacob, will need all his skill and firmness of purpose in directing the Corporation through the troubles that lie ahead. Revolutionary changes have been proposed in both sound and vision, and at no period of the B.B.C.'s existence has there been greater need for a firm directing hand.

* Annual Report and Accounts of the British Broadcasting Corporation for the Year 1951-52. Cmd. 8660. H.M.S.O. 4s 6d.

Metal Cone Loudspeaker

Principles Underlying the Design of the G.E.C. High-quality Reproducer

By F. H. BRITTAIN*

WHEN loudspeakers were first introduced, their prime duty was to make a loud sound; something more than the whisper which was all that the telephone could produce. At that time, poor magnetic materials restricted the sensitivity of the loudspeaker, whilst the small output power of the amplifiers then in use made the reproduction of loud sounds rather difficult to achieve. The result was that sensitivity was sought at almost any price. That price was nearly always the uniformity of the frequency response of the loudspeaker, which was so woefully inadequate that other types of distortion were scarcely noticed.

Frequency Response.—Under these conditions, it is not surprising to find that much attention was paid to the frequency response curve, which, at that time, gave a fair indication of the performance of the loudspeaker. In order to study the frequency response of the loudspeaker, it was necessary to measure it under conditions which did not modify its behaviour, that is, in the equivalent of free space. Incidentally, it is believed that the first echo-free room to be built for this purpose in this country was constructed at the Research Laboratories of The General Electric Company in 1930.

* Research Laboratories of The General Electric Company.

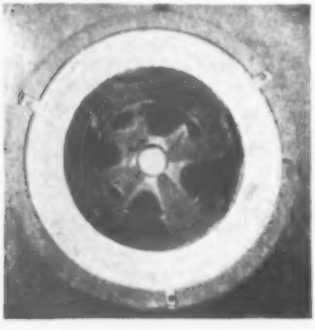


Fig. 1. Cone break-up in radial modes at medium frequencies is little affected by the introduction of circular ribs.

Harmonic Content.—As time went on, the frequency response of loudspeakers was greatly improved, and it was no longer the overriding consideration that it once had been. With this improvement in the frequency response, other forms of distortion, which had previously passed unnoticed, came into prominence. By the year 1934, it was realized that far more information was required for the appraisal of a loudspeaker than was provided by the frequency response curve alone. Accordingly, the measurement of the harmonic content of a loudspeaker output was undertaken.

The results showed that some of the loudspeakers which had the best frequency response had also the worst harmonic distortion. This was particularly true of the "curved" or "flared" cone which was introduced at about this time. Before the advent of the "curved" cone, there were two methods in general use for reducing the prominence of the main high-frequency peak in a moving-coil loudspeaker. In the most usual method, this resonant peak was reduced by the use of a soft paper cone with considerable internal damping. The softness and internal damping of the paper were very difficult to control and both the "blocking" operation in the manufacture of the cone and its final waterproofing caused considerable variation in its internal damping. This had the unfortunate result that the cones varied in softness during a production run, giving rise to a variation in the quality of the loudspeakers into which they were built.

The alternative method was to use a rather harder paper which often had a series of corrugations moulded into it, in order that it might "break up" at high frequencies and not vibrate in only one pronounced mode.

The curved cone, on the other hand, reduced the high-frequency peak by the fact that its stiffness to forces applied over the surface of the cone in an inward direction was different from its stiffness in an outward direction. This non-linear stiffness of the

curved cone gave rise to the production of harmonics and severe cross-modulation. These defects caused the reproduction of numbers of voices or instruments to sound "muddled" although good reproduction of a solo instrument or voice could be obtained.

Cone Break-Up.—The phenomena associated with cone break-up were investigated in these laboratories by the classical use of lycopodium powder. The investigation showed that a cone collapsed into radial modes at quite low frequencies, and that circumferential ribs did little to improve this lack of rigidity. Fig. 1 shows a cone after it had been dusted with lycopodium powder and then driven at a small amplitude. It will be seen that the break-up pattern passes right through a corrugation in the cone material. Fig. 2 shows a series of these break up patterns, and relates them to the response curve of the loudspeaker. It is interesting to note that they do not necessarily coincide with major peaks or hollows in the response curve. This is because the "phase" of the various sections is important. They could, for example, all cancel out and give almost no sound output. But while they may cancel out at the fundamental frequency, it does not follow that they will also cancel out at harmonic frequencies.

A Rigid Cone.—As a result of these tests, it was decided that an attempt should be made to construct a cone which was as rigid as possible for the sole purpose of studying its harmonic production. The material chosen for this cone was Duralumin, and a very considerable increase in rigidity compared with paper was obtained. As expected, the efficiency of the loudspeaker was very low due to the weight of the cone. Its frequency response was irregular in the "top," due to the very low internal damping of the cone material. However, the experiment was informative because the harmonics due to cone break-up were very considerably reduced and a marked change in the quality of reproduction was apparent. The Table, compiled from measurements taken in 1935 compares the harmonic production, at a frequency of 80 c/s, or a Duralumin cone and a curved paper cone.

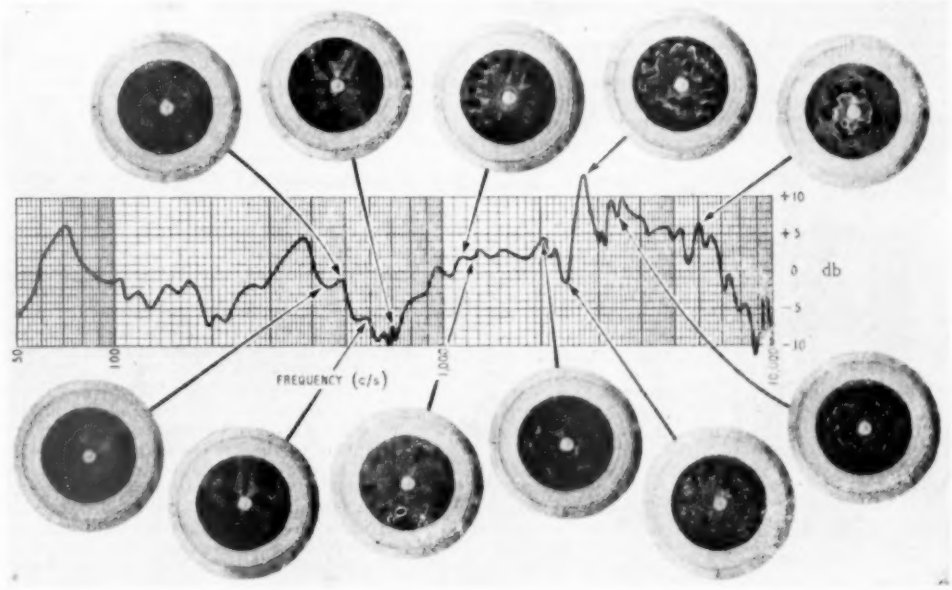
TABLE

Amplitude of harmonics (db relative to fundamental of frequency 80 c/s)

Harmonic	2nd	3rd	4th	5th	6th	7th	8th	9th
Curved-sided paper cone ..	−14	−16	−22	−27	−36	−45	−53	−57
Duralumin cone	−36	−25	−38	−39	−66	−54	−67	−69

Driving-force Distortion.—So far, only those harmonics which are caused by the flexing of the cone have been considered. There is, however, a second series of harmonics, whose fundamental frequencies are much lower. They are caused by the non-uniform nature of both the driving force applied to the cone by the voice coil and the restoring force which returns it to its position of rest. In order to study the distribution of magnetic flux in and near the air gap of the magnet, a special instrument was designed. This device permitted a small search coil to be introduced into the air gap of the magnet, step by step, a few thousandths of an inch at a time. Fig. 3 shows this instrument. Because it is necessary to maintain a

Fig. 2. Typical break-up patterns in a moving-coil cone loudspeaker and their associated points in the frequency response curve.



uniform driving force on the voice coil, even when it is displaced by large-amplitude, low-frequency sounds, either the voice coil or the air-gap must be relatively long so that one can always embrace the other. It is unfortunate that, even to-day, there are many loudspeakers in which the length of the air-gap and the voice coil are approximately equal. This arrangement results in maximum efficiency at the price of maximum driving force distortion. From a knowledge of the flux distribution, and the excursion of the voice coil, it is possible to evaluate the linearity of the driving force. The designer has then to select a compomise between linearity and efficiency. Fig. 4 shows a graph which relates the force on long and short coils, and their displacement along an air gap.

Restoring-force Distortion.—In order to obtain an undistorted output, it is necessary to make not only the driving force uniform; but also to ensure that the restoring force arising from the stiffness of the suspension is linear. The behaviour of the cone-restoring forces in a loudspeaker was studied by means of the laboratory stiffness meter shown in Fig. 5, which was designed in these laboratories expressly for this purpose. The stiffness of the centring device, and of the cone surround material, were first studied separately, and then in combination. The problem of the designer is to reconcile linearity of restoring force with a finite cone movement. It has been found that an abrupt termination of cone movement is undesirable, except in very carefully regulated laboratory experiments, with no possibility of overload. For normal use, approximately half the total travel should be linear, with an increase of stiffness at each end. Because of major cause of harmonic production at low frequencies is due to the large excursion of the cone and voice coil, this excursion should be kept to a minimum by providing the cone with adequate acoustic loading.

If, for any reason, it is impossible to provide such loading to limit the travel of the cone at low frequencies, it is desirable to take suitable precautions in the loudspeaker itself. In the case of domestic radio receivers, those loudspeakers which are to be used in "table" model cabinets often have a higher frequency of main resonance than those which are to be used in large radio-gramophone cabinets. However, raising the frequency of the main bass resonance of the loudspeaker may easily bring it within the range of the fundamental frequency of the human voice. If this happens, the severe overhang transient distortion associated with the resonance will be particularly noticeable, and speech will sound very "boomy."

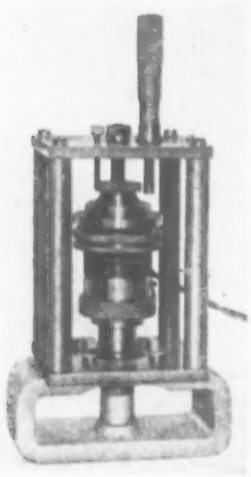


Fig. 3. Device for measuring the distribution of flux in the air gap of a magnet.

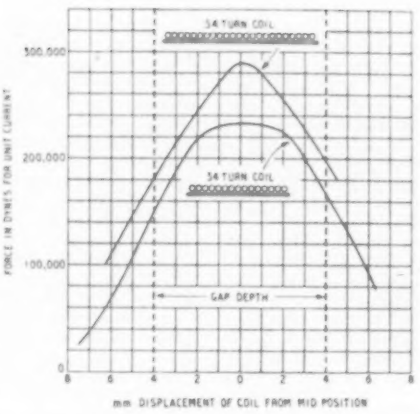


Fig. 4. Relation between force and coil displacement for voice coils of different lengths working in the same gap.

In the case of a high-quality loudspeaker for use in a small cabinet, for speech reinforcement purposes only, the most satisfactory solution is obtained by the use of a surround material with a fairly high damping factor. By this means it is possible to keep both the electrical and the mechanical impedance of the loudspeaker largely resistive. This minimizes transient distortion, and reduces the production of harmonics, by inhibiting excessive cone movement.

Design of a High-quality Loudspeaker

In the light of results which had accumulated over a number of years an attempt was made to design a high-quality loudspeaker. This involved many attempts to increase the rigidity of a paper cone, in order to reduce the generation of harmonics and cross modulation. All attempts came far short of the standard reached by the metal cone and it was decided to study its performance in greater detail. This investigation showed that the main defects were low efficiency and poor frequency response, and, as a result, poor transient response. It was considered that for certain applications at least, the low efficiency could be met by increasing the output power of the amplifier.

A consideration of frequency response of the metal cone loudspeaker showed that the worst trouble occurred in the upper frequency region, and took the form of a dip in the response curve followed by a peak of considerable size at a frequency of about 8,000 c/s, as shown in Fig. 6(a).

It was observed that although there was a dip in the response of the loudspeaker when measured from the front, there was no corresponding dip in the response from the rear of the loudspeaker. Investigation showed that the low output from the front was largely due to interference between different parts of the cone. A stationary "bung" was inserted in the cavity of the cone, whose function was simply one of obstructing certain paths which the sound might take across the cone at high frequencies. The "bung"

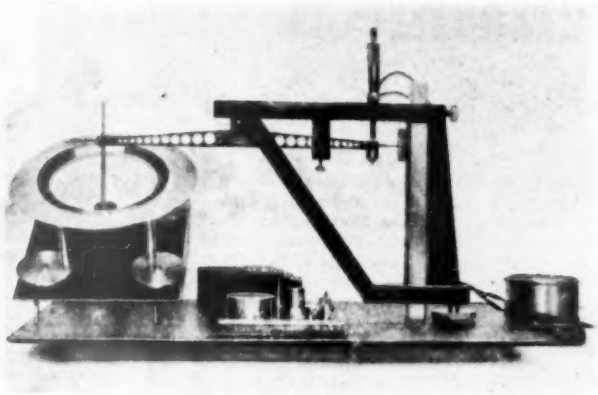


Fig. 5. Laboratory stiffness meter. The apparatus may be set up for measuring the stiffness of cone surround and centring device as well as for exploring flexibility of the cone material at different points on the surface.

may be solid or hollow, so long as it is rigid. Fig. 6(b) shows the response curve of a metal cone with a "bung."

The mechanism by which the cone produces the main high-frequency peak is briefly as follows. Consider a narrow radial strip of the cone, from the voice coil tube to the outer edge. Such a strip could be fixed at its ends, and driven in such a way that it resonated at some particular frequency. Its greatest amplitude would occur near, but not exactly midway between, the supports. There are two factors involved. First, the radial strip is not parallel sided, but is a segment of a circle. Second, the strip is curved, the radius of curvature being least at the centre and greatest at the periphery. This curvature has the effect of increasing the stiffness of the strip, the greatest stiffness occurring at the apex of the cone. The result is that maximum amplitude occurs at a position about one-third of the way from the periphery to the voice coil tube.

Now, if all the radial strips or segments are exactly similar, they will all resonate at the same frequency, and will all be "in phase" with each other. The result will be a very large resonance peak in the response curve, corresponding with a very large output at that particular frequency, unless there is considerable damping in the material of the cone. Alternatively, its rigidity can be made so poor that it breaks up into a number of different modes, thereby upsetting the symmetry of the radial strips. Duralumin has very low internal damping, compared with paper, and a very weak cone is incompatible with the rigidity which is necessary to reduce the generation of harmonics and cross modulation.

The simple solution to the problem consists in making the natural frequency of some of the radial strips different from that of other radial strips. It is necessary to achieve this alteration in resonant frequency without reducing the stiffness of the cone, particularly to deformation of its circularity. The introduction of radial ribs into a metal cone might seem to be a solution, but the consequent lack of rigidity of the cone as a whole completely inhibits the production of the highest frequencies. It was found that the high-frequency resonance peak could be controlled, at least to some extent, by annular rings pressed into the diaphragm. But such a cone gave noticeably more "muddle" than one without annular rings, the individual rings interfering with each other.

The method finally adopted for making the resonant frequency of one radial strip of the cone different from that of another, was to make a series of circumferential incisions in the cone. That portion of the cone immediately within the incision, that is, nearer to the voice coil tube, was then bent, as shown in the photograph in the title of this article, to a uniform radius. This gave a different resonant frequency to the section so treated, yet retained the rigidity of the cone as a whole.

It will be apparent from the foregoing description of the mechanism of the production of the high-frequency peak in the response curve of a loudspeaker that the method adopted for its removal, in the case of the metal cone, can also be applied to a paper cone. A considerable improvement in the frequency response may also be expected if this treatment is applied to a straight-sided paper cone. Because paper cones are almost invariably moulded, it is quite possible to dispense with the incisions, and to mould into the cone the suitable deformations. The incisions are used in the case of the metal cone only to ease the operation of distorting a small piece of the cone.

This treatment is not suitable for use with "curved" cones, where the curvature already prevents the formation of the high-frequency peak. This same curvature is also responsible for the considerable cross modulation and "muddle" which is produced by such cones. Fig. 6(c) shows the response curve of a metal cone loudspeaker which has had the cone treated to remove the high-frequency peak and has been fitted with a "bung" to reduce cavity effects in the metal cone.

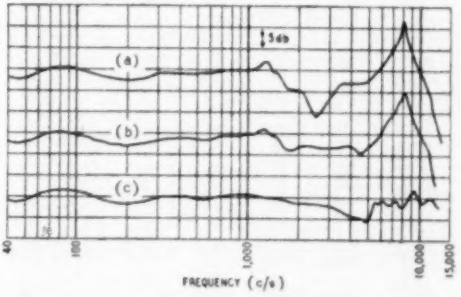


Fig. 6. Frequency response curves of metal-cone high quality loudspeaker when mounted in a vented cabinet with fairly heavy damping: (a) uncorrected plain cone (b) plain cone with "bung" (c) "slotted" cone with bung.

Aerial Exchange

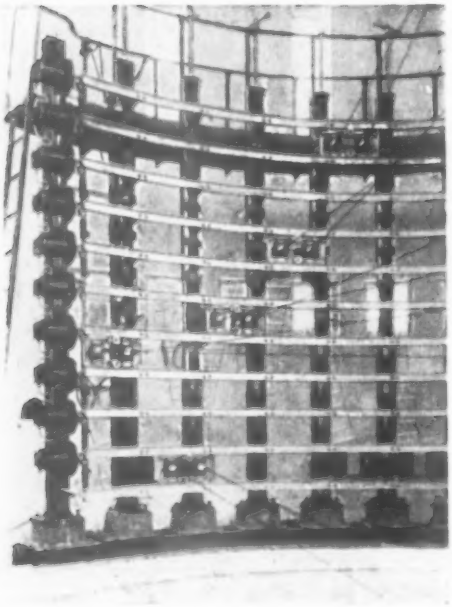
Switching on the Grand Scale for Ten Radio Transmitters and Twenty Aerials

PRACTICAL effect has recently been given at one of the Admiralty's high-power transmitting stations to a requirement calling for elaborate planning and precision engineering. This requirement was to provide a reasonably simple scheme for connecting any one of 10 radio transmitters to any one of 20 different aerial systems. Some are rhombics, others dipoles, but all have one common feature which is that 600-ohm balanced open-wire transmission lines are used.

The main problems were to provide a way of switching which would not disturb the characteristic impedance of any of the lines and to handle 25 kW of r.f. power. Changeover is not carried out with power on the lines.

The switching system is partially motorized and consists of a large semi-circular structure of 14 ft radius and some 16 ft high. This is fitted with 11 horizontal rails and between each pair is a movable carriage. Each carriage is driven by a small electric motor through flexible shafting and they can be traversed from end to end of the structure. There are 10 such carriages and their driving motors can be seen stacked on the left of the illustration.

Part of the aerial exchange switching frame. Horizontal traversing motors are stacked on the left and a few of the hand winders for the vertically moving carriages are seen round the top gallery. Aerial feeders are just visible in the background.



Similar carriages, but travelling vertically between the upright pillars, are mounted at the back of the structure. There are 20 of these and they are moved up or down by hand-operated lead-screws, the controls for which are arranged round a gallery at the top of the framework.

Each carriage, vertical and horizontal, is fitted with two large insulators having on their inner faces domed-shaped contact studs. The spacing is exactly 10-in which is the same as that of the transmission lines.

From a vertical column located at the exact centre of the system is taken a two-wire transmission line to each of the horizontally moving carriages. These lines are under spring tension and remain taut at all positions of the carriages. From this column the feeders pass into the transmitting hall and thence to the various transmitters.

Similarly, to each vertically moving carriage is brought, through a separate window in the outer wall of the building, a 600-ohm transmission line from one of the aerials; there are 20 in all and some of the lines can be seen in the illustration draped from the frame to the windows.

The method of switching is now fairly obvious, the carriage carrying a transmitter feeder is moved horizontally to the required aerial bay and that aerial's feeder carriage is moved up or down to bring the two sets of contacts into alignment. The rear set of insulators is on a sprung plate which ensures a firm and good electrical connection.

Initial planning of the system was carried out by the Admiralty Signal and Radar Establishment and the installation was engineered by P. & L. Miller, Ltd., of Heneage Street, London, E.1.

"Negative-feedback Tone Control"

OWING to an omission from the inscription to Fig. 6 of the above article in the October issue, some ambiguity has arisen regarding the law of the potentiometers P_1 and P_2, though from the curves of Fig. 8 it is implicit that they are linear. The relevant part of the inscription to Fig. 6 should read "P_1 and P_2 must both have linear elements. P_2 is Dubilier Type 'C' control, 500 kΩ, with fixed tapping at 50 per cent rotation."

The dotted curves of Fig. 8 with P_2 centre tap disconnected were measured with an input attenuator forming a return path for the grid. When the filter is fed via a capacitor (as in Fig. 6), and the modified response is required, the grid may be "tied down" to earth by a high-resistance leak, but the preferred method is to use two 330-kΩ resistors, one from the left-hand and the other from the right-hand end of P_2 to earth, the central tap being disconnected. The lower value of resistors avoids possible trouble from leaky coupling capacitors, and/or slight grid current, without appreciably affecting feedback and non-linearity distortion.

Reshaping Information

to Suit the Channel

Practical Applications of Communication Theory

HOW to transmit information efficiently is the big problem in communications engineering these days: given certain properties like time, bandwidth and signalling power, how to make use of them in the best and most economical way. Quite often the "efficiently" implies transmitting the information in as small a bandwidth as possible, but not always so. Sometimes it means conveying it in a short time, or with a limited signalling power, or through a high noise level. At any rate there is usually some restriction or other, and because of this it is not always possible to transmit the information in its original form. It has to be reshaped, or encoded, as the communications engineers like to say, to suit the peculiarities of the channel.

This encoding of information to suit the channel was one of the dominant themes in a symposium on "Applications of Communication Theory" which took place in London recently. The symposium was organized by Professor Willis Jackson of the Imperial College of Science and Technology and was held at the Institution of Electrical Engineers. Forty papers were presented altogether over a period of five days by authors of seven different nationalities. About one-third of the 300 people attending were visitors from abroad (representing 18 different countries, including Russia), while the remainder came from universities, Government establishments and industrial concerns in this country.

Speech Information

One group of papers described various approaches that are being made towards the reduction of bandwidth in speech communication. The general method envisaged is to transmit not the speech waveform itself but a series of "telegraphic" signals representing the significant sounds in the speech. A teleprinter channel, for example, is capable of transmitting speech encoded into writing at the same rate as spoken speech and in a bandwidth of only about 75c/s. The great difficulty, though, is how to convert the speech sounds into code signals to begin with, especially when the sounds vary a great deal with different speakers.

Two of the papers described attempts that have been made to devise an automatic speech "recognizer" for this purpose. In both cases the machine works on the principle that a speech sound is characterized by concentrations of energy at particular frequencies in the acoustic spectrum (Fig. 1), and can be identified fairly well by a coincidence of two of these frequencies. The apparatus, then, is basically a spectrum analyser feeding into a bank of coincidence detectors, which indicate when energy concentrations of certain frequencies occur at the same time.

Unfortunately this type of recognizer is unable to cope with different pronunciations of the same word unless specially adjusted for each new speaker. In one of the machines, however, an attempt is being made to overcome this limitation by working on the principle that the human being is able to recognize words with different pronunciations because he has a store of linguistic information acquired from experience of the language to help him. The idea, then, is to "build in" a store of such information which will give the final yes or no to the recognition achieved by the acoustic system. For the moment this built-in information is confined to the known probabilities with which certain sounds occur after each other in English. The operation of a relay by the acoustic recognition of a sound is either facilitated or inhibited by the relay which recognized the previous sound, according to the known probability of these sounds occurring together.

Having converted the sounds into telegraphic signals, the task of converting them back into speech at the receiving end is comparatively easy. The signals merely have to switch on appropriate sound generators. One paper described a speech "synthesizer" working on this principle in which the bandwidth needed for the telegraphic signals was less than 100c/s. A tape recording of the reconstructed speech was played, but the effect was monotonous and difficult to follow until one became accustomed to it.

Another machine, which was described and demonstrated, gave a much more passable imitation of real speech because it was based more directly on the human vocal mechanisms. In this it was not a matter of "patching together" a series of discrete and standardized sounds. The code signals represented the comparatively slow and continuous muscular

Fig. 1. Acoustic spectrograms of the spoken words "two" and "mine" made by Bell Telephone Laboratories for their book "Visible Speech." The frequency analysis is displayed on a horizontal time axis, so the black bands represent concentrations of energy at particular frequencies, which vary throughout the speaking of the word.

movements of the human speech mechanisms, and gave simultaneous control of five sound generators equivalent to the human generators. The first three generators produced the most prominent resonant frequencies of the vocal cavity, the fourth gave out pulses corresponding to the excitatory pulses of air from the larynx, while the fifth was a noise generator for imitating the fricative sounds associated with consonants. The "muscular" control signals are obtained by optical scanning from time graphs of the required variations drawn on glass slides. Because of their slowly varying nature they have an information rate (in bits/second) about one-fiftieth of that of the speech waveform itself so they make possible a considerable reduction in bandwidth. The only problem that remains is how to obtain this type of control signal automatically from the original spoken sounds!

Reducing Television Bandwidth

Television signals, of course, are notorious for the amount of bandwidth they occupy. They have one characteristic, however, which offers a great opportunity for reshaping the information, and an interesting paper at the symposium showed how this could be exploited to give a reduction in bandwidth. In a television picture, most of the information is concentrated in the sharp edges and boundaries, which are represented by the same sort of sharp variations in the waveform. But these edges only occupy a very small area of the picture, so that the large bandwidth made necessary by them is only utilized completely for a small part of the total time. The suggestion is, then, that some of the time that is normally wasted on transmitting the flat redundant parts of the waveform should be devoted to these sharp edges. And, of course, if one takes a longer time over sending a piece of information the bandwidth required for it is reduced. The desired effect, then, is to smooth out the waveform and spread the information more evenly over time.

To achieve this, the paper suggested a method using variable velocity scanning in the camera pick-up tube. The beam is slowed down when it comes to the sharp transitions on the mosaic and speeded up across the flat unchanging portions. This variation in velocity is controlled automatically by the nature of the picture itself, as represented by the output waveform. The slope, or sharpness of the waveform is measured continuously by a differentiating circuit, and this serves to control the scanning velocity. The high slope of a sharp edge tends to slow down the beam, so that the slope is itself progressively reduced until it finally settles down to an equilibrium value. Similarly, a low slope causes the beam to go faster. The result, as can be seen from Fig. 2, really amounts to a feedback system in which the beam velocity is controlled by a parameter which is itself derived from the velocity. In the receiver, of course, the scanning beam of the c.r. tube is varied in synchronism, and the information for doing this is derived from the modified slopes of the received waveform.

A somewhat similar system was suggested in another paper for the transmission of simple line drawings or graphs. The scanning spot is made to go very fast over the large white areas until it comes to the drawn line. It then stops and sends out a code signal, which tells the receiver how much time has passed since the last encounter with the line. Thus, instead of spending a great deal of time in transmitting the large white areas, as in normal scanning, one merely sends code signals representing the extent of these areas. The immediate result of reshaping the information in this way is to reduce the transmission time required for the picture, but by spreading the reshaped information out over the normal time this can be translated into a bandwidth saving.

Coded Colours

In colour television the bandwidth problem is even more acute. The reason is, of course, that one has to send information about a particular colour in terms of its three primary colour components, so that three channels are needed. Various methods have been proposed for reducing the bandwidth by successive sampling of the three components, but one paper at the symposium outlined an entirely new approach. It pointed out that instead of sending information about the components of a particular colour, one need only send a code signal representing the colour itself.

In the system suggested, the colour is first of all analysed into its three components in the usual way by three pick-up tubes with filters in front. The three voltage outputs then form a special combination which actuates the transmission of a particular code signal. In this way each colour produces its own combination of voltage outputs and its own code signal. The principle is, of course, very similar to that of the automatic speech recognizer mentioned earlier, in which the code signal is actuated by a particular combination of sound components. At the receiving end the reverse process is carried out. The

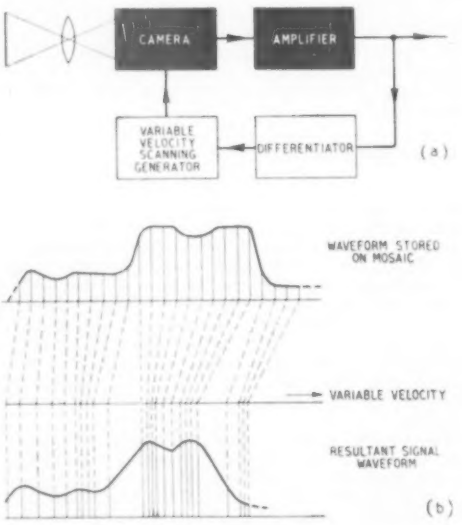


Fig. 2. Reshaping television signals. At (a) block diagram of a system for controlling the velocity of the camera scanning beam according to the amount of information in the picture. At (b) is the television waveform: (above) as recorded on the mosaic, and (below) as it appears after variable-velocity scanning.

received code signal generates three voltages corresponding to the outputs of the pick-up tubes, and these are applied to a trichromatic c.r. tube to reproduce the three components and reconstitute the original colour.

Two other communications systems were described in which high efficiency was obtained by reshaping the information. The first, known as "delta modulation," has already been outlined on page 427 of the October issue. In this the original information about the absolute voltage levels of the waveform is reshaped into information about the changes in the waveform. This is done by a kind of servo system in which the original waveform is followed automatically by a quantized version of itself. The two are compared with each other and the resultant error signals represent changes in the waveform. These error signals are used to make the quantized version follow the original waveform, and are rather like the series of corrections that one applies to the steering wheel of a car to keep it going in the right direction. They are transmitted in the form of pulses, from which a quantized version of the waveform is reconstructed at the receiving end. The advantage of this system is in its high signal-to-noise ratio, which is obtained at the expense of a wide bandwidth. In this respect the efficiency is about the same as pulse code modulation, but the apparatus required is very much simpler.

The second system, described as the "ambiguous-index system," is even more efficient. Not only does it give a high signal-to-noise ratio, but with a bandwidth not very much greater than that required for simple amplitude modulation. The original waveform is sampled and the value of each sample is represented by two or more independent code signals (the "indexes"). These code signals are transmitted and from them the original samples and waveform are reconstructed at the receiver.

Overcoming Noise

As "Cathode Ray" explained in the September issue, information can be reshaped to overcome noise by introducing a certain amount of redundancy into the message. One way of doing this is to repeat the signal several times over, so that in systems where the signal is repetitive or periodic to begin with (radar, for example) the problem is very much simplified. Several papers showed how one can utilize this inherent redundancy for extracting signals from noisy backgrounds by a process of integration. The point is, if the periodicity is known at the receiving end, one can use some device which responds to it and so integrates the signal but not the noise. One paper described several ways of doing this visually by oscillographic methods. The time base is adjusted to the known periodicity, then as each signal arrives it is superimposed on the previous ones. Storage and integration is done partly by the screen of the c.r.t. and partly by the observer's persistence of vision. Thus a pattern is produced by the integrated signal which shows above the unintegrated noise.

The disadvantages of this visual method are, of course, that the integration time is limited by the short optical persistence of the screen and eye and that the integrated signals cannot be passed on in electrical form. By replacing the fluorescent screen with a plate of some dielectric material, however, the information "written" on it by the electron beam

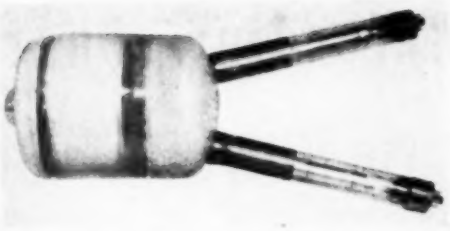


Fig. 3. Electrostatic storage tube for signal integration showing the two electron guns, one for "writing" the signal repeatedly on the target plate and the other for "reading" off the integrated result.

can be stored and integrated as a pattern of electrostatic charges, which can be "read off" whenever required. This was the principle of a new kind of electrostatic storage tube described in one paper (Fig. 3). The signal modulates the intensity of the electron beam so that the charge pattern on the plate consists of variations in charge density. Integration is obtained, as in the c.r.o., by superimposition of successive traces, which gives an increase in density of the charges representing the signal. The pattern is "read off" by a second electron beam scanning across it. The secondary emission produced by this "reading" beam is modulated by the variations in the charge pattern, then collected by another electrode to give a fluctuating current representing the integrated signal. With a noise-to-signal ratio of 7db, it is necessary to integrate about 300 successive traces to make the signal stand out about the noise.

Another paper described an alternative method of storing and superimposing the required signals. That is, to keep them circulating in a magneto-striction delay line in which the delay time is the same as the interval between successive signals. Thus the first signal travels round and gets back to the feed-in point (a magneto-striction transducer) at just the right moment to have the second one superimposed on top of it, and so on. Here, the integration is limited by the attenuation of the delay line.

Practice Before Theory?

It might be argued that some of the schemes described above do not really justify the title "Applications of Communication Theory." One has the feeling that they would have been thought of anyway, whether Communication Theory had been here or not, and that the Theory was only dragged in at the last minute to explain things on a more scientific basis.

To some extent this is true. The real application of the Theory is in the detailed working out of these schemes, in that it provides a way of measuring information and of relating it mathematically to familiar parameters like bandwidth and signal-to-noise ratio. In this way it is essential to the engineering of any scheme in which information is the raw material. At the same time, there is no doubt that the general ideas provided by the Theory—such as redundancy and inverse probability—have been extremely valuable in stimulating original lines of thought that will eventually materialize in the shape of new technical developments.

Recording Characteristics

Problems of International Standardization for Broadcasting

IN his inaugural address to the British Sound Recording Association the new president, H. Davies, M.Eng., M.I.E.E., took for his subject the problems of international standardization in sound recording, with particular reference to the exchange of programmes between broadcasting organizations.

Mr. Davies dealt with both mechanical and electrical standards and gave some interesting details of the many factors of expediency as well as of a purely technical nature which have influenced the figures finally adopted by the C.C.I.R. For instance, tolerance on 33⅓-r.p.m. turntable speeds is normally 0.5 per cent but in the case of 78 r.p.m. this was widened to 0.7 per cent. The reason for this is that whereas a 180-bar stroboscope on 50 c/s and a 216-bar on the American mains frequency of 60 c/s give exactly 33⅓-r.p.m. when the image is stationary, the customary 77-bar (50 c/s) and 92-bar (60 c/s) stroboscopes for 78-r.p.m. actually give 77.92 and 78.26-r.p.m. Again, the rival claims of 77 cm/sec and 30 in/sec as basic standard tape speeds were settled in favour of 30 in/sec for the simple reason that it would be easier to reduce the capstan diameters of 77-cm/sec machines than to build up the diameter of capstans in 30-in/sec machines.

On the subject of recording characteristics it was possible to err, according to Mr. Davies, by saying too much as by too little; there was much opinion and all-too-often obscurity of fact. In the case of recording for broadcasting the signal taken from the line was already processed to suit the transmitter, and the object of recording and playback was to preserve that signal unchanged. The term recording characteristic was defined as the output (groove velocity, film density or area, or surface magnetic induction of tape) produced by constant input. It did not take account of any corrections or modifications made outside these limits. The first consideration in the choice of a recording characteristic was, or should be, optimum signal/noise ratio, but the characteristic so derived held only for single tones and might have to be modified by other considerations, including the distribution of energy in the sound spectrum. Norwegian speech, for instance, shows a marked tendency to overload at high frequencies. One should aim at equal probability of distortion over the frequency range, and the optimum characteristic would then give the least distortion for a given background noise.

Mr. Davies underlined the fact that these considerations held only for the internal recording characteristic decided upon by the broadcasting organizations. Manufacturers of commercial gramophone records might follow this good example at some future date, but the characteristic would not necessarily be the same, since the characteristics of reproducing equipment in the hands of the public varied over much wider limits than those of broadcast transmitters.

Standardization of characteristics for magnetic tape recording had presented some difficulty because the intensity of magnetization could not readily be measured by inspection, as it could with the microscope or the Buchmann and Meyer method in disc recording. It was difficult, therefore to separate the performance of the playback head from that of the tape, and early proposals aimed at the use of equalizers to correct assumed head losses due to the finite gap and to eddy currents. Recent research by the B.B.C., using a single copper conductor as a playback head, had resulted in more precise segregation of the iron losses and a reconciliation of the previously anomalous figures derived from iron heads, using short and long gaps. It was now possible to derive the tape magnetization by three independent methods, and in this respect the position was now better than for lateral-cut discs.

In conclusion, Mr. Davies spoke of the high standard of reproduction now being achieved with a tape speed of 7½in/sec and of the very considerable groundwork which had been carried out on this side of the Atlantic with the object of establishing international standards for this speed.

SMALL TELEVISION CAMERA TUBE

WHETHER or not it is worth while applying television techniques to industrial processes depends very much on whether the camera equipment, in particular, can be made sufficiently simple and inexpensive. In this country Pye have recognized this requirement by producing a small and light camera containing an exceptionally small pick-up tube. Now, another miniature tube designed for such applications has been put on the market by R.C.A.—the type 6198 Vidicon. It measures 1in in diameter and 6½in long. The light-sensitive element is a photoconductive layer, and has a sensitivity which permits the televising of scenes with 100-200 foot-candles of incident illumination. The tube has magnetic focusing and deflection, and requires d.c. voltages on the electrodes of no more than 300 volts.

In operation, the photoconductive layer acts as a leaky capacitor, and when the scene is focused on it the "plate" nearest the scanning beam acquires a corresponding pattern of positive charges. In the process of scanning, the deposition of electrons from the beam reduces these charges on the near "plate" to the potential of the cathode. As a result there are changes in the potential difference between the two "plates" of the photo-conductive layer, and these constitute the output signal.

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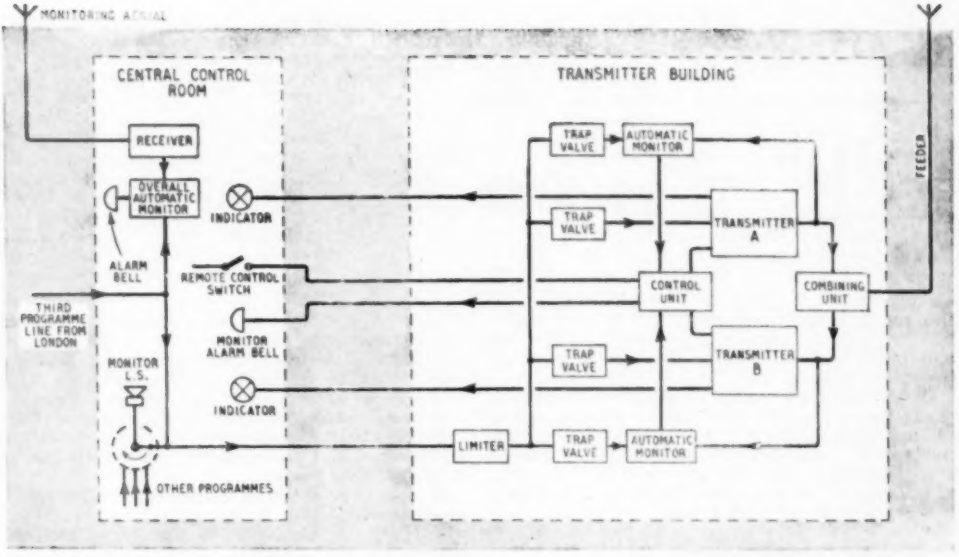


Fig. 1. Block diagram showing the general arrangement for remote control and automatic monitoring of the transmitter.

Automatic Broadcasting

Remote Control and Automatic Monitoring of Third Programme Transmitter

By R. W. LESLIE* and C. GUNN-RUSSELL, M.A.†

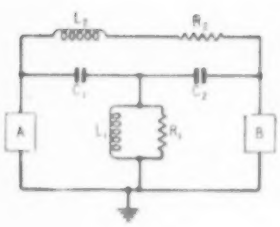
THE B.B.C. has for some time operated low-power medium-wave transmitters by remote control. A more recent development is the application of remote control to a high-power transmitter. The Third Programme transmitter at Daventry was selected for the first installation of this kind, the transmitting equipment being of suitable design for this purpose. Normally at least two engineers per shift would be required to operate such a transmitter. The remote control system has been developed jointly by B.B.C engineers and by Marconi's Wireless Telegraph Company, the manufacturers of the transmitter.

A prime requirement of a broadcasting service is that breakdowns shall be kept to an absolute minimum, and various methods are employed throughout the system to ensure reliability. Where the cost of equipment is low, duplicate apparatus is installed and is available instantly to carry the programme should the need arise. Where a number of similar units are used, one extra unit is installed and is available as a spare for the others.

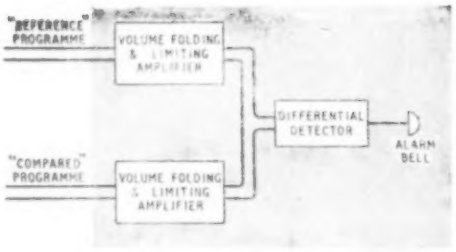
The capital cost of a high-power radio transmitter precludes the installation of duplicate equipment which would be used only in the event of a breakdown in the service equipment. A method which overcomes this expense has been used by the B.B.C. for a number of years. Two transmitters, each capable of providing half the required output power of the station, are installed and operated in parallel to produce the required total output power. Should a fault occur on either transmitter the remaining one can be switched direct to the aerial in a matter of seconds and the service maintained with a loss of only 3db to the listener until the faulty unit has been restored to service. This principle has been extended at Daventry so that the transmitters are switched on and off from a remote point, and when a fault develops it is automatically detected and the equipment itself takes appropriate action to maintain the programme service.

The general arrangement of the equipment is shown in Fig. 1. The lines which carry the various programmes for all the transmitters at Daventry terminate in a central control room in the main short-wave transmitter building. As the short-wave services necessitate the control room being staffed on a 24-hour basis, it is convenient to locate the Third Programme transmitter on/off control switch and alarm circuits for fault indication in the same room. Here,

* Planning and Installation Department, B.B.C.
† Designs Department, B.B.C.



Left : Fig. 2 Circuit of combining unit by which the two transmitters A and B are paralleled to the common aerial feeder impedance R_1.



Right : Fig. 3 Essentials of the automatic monitor.

also, the programme is amplified and fed to a nearby building, which contains the Third Programme transmitter, and to line for distribution to other transmitter stations.

On arrival at the transmitter building the programme passes through a limiter to prevent overmodulation and trap-valve amplifiers to give independent outputs, one of which is used to feed transmitter A and another to feed transmitter B. The outputs of the individual transmitters are fed to a combining circuit, the output of which goes to the aerial feeder.

Unattended Transmitters

The transmitters, which are air cooled and rated at 100kW each, together with the combining circuits, were designed and installed by Marconi's Wireless Telegraph Company. High-speed overload systems afford each transmitter complete protection from damage following a fault. In the case of the main h.t. supplies, recycling electronic overload trips are fitted which, under fault conditions, remove the h.t. and re-apply it a predetermined number of times before switching it off permanently. If this were not done, any fault of a transient nature would cause one or both transmitters to remain closed down after the fault had cleared.

Automatic monitoring equipment has been installed to maintain a continuous check upon the fidelity of transmission in place of staff listening continuously to a loudspeaker. A separate monitor is associated with each transmitter, and an overall monitor compares the quality of the radiated programme with that incoming from London.

Incidentally, the quality of the incoming programme is checked in two ways. First, it is continuously aurally monitored at one of the other stations which has received its feed of Third Programme via Daventry. Secondly it is intermittently monitored in the central control room. The loudspeaker shown in Fig. 1 is connected to a sequential switch arranged so that one of the staff may listen to each source of programme in turn. The switch normally dwells for about thirty seconds in each position.

In order that each transmitter monitor can check the output of its own transmitter without being affected by the condition of the other, it is necessary to have a combining network which allows two transmitters to be paralleled to a common load but which provides a high attenuation between them. For this purpose Marconi's have developed a bridge T network as shown in Fig. 2. Here R_1 represents the aerial feeder impedance, which in this case is 220 ohms, R_2 is a ballast resistor and A and B represent the transmitters. With values chosen such that $(X_{L1}) = (X_{L2}) = R_2 = R_1$ the impedance presented to either transmitter is independent of the terminal impedance of the other, being equal to R_1 ; and if a fault causes one transmitter to close down the other will continue to work normally. As a corollary of the impedance relationship it also follows that none of the output of one transmitter can appear across the output of the other, and hence the two transmitters can be monitored independently.

Although the operating conditions of either transmitter are unaffected by the condition of the other, when only one transmitter is functioning the total radiated power is reduced to a quarter of normal since half the power of the working transmitter is dissipated in the ballast resistor. However, this state of affairs will only persist for fifteen seconds as, at the end of this period, if one transmitter is still closed down, r.f. contactors are arranged to select the working transmitter and connect it direct to the feeder so that its full power output is radiated.

The automatic monitor, which was developed by B.B.C. engineers, works on the basis of comparison. It compares programme of unknown technical quality, dubbed "compared" programme, with programme that is known to be satisfactory, called "reference" programme. If the quality of the "compared" programme falls below a certain standard the equipment either gives an alarm or may initiate executive action to deal with the trouble. The standard of imperfection adopted for the equipment was based on the performance of a human monitor.

As the automatic monitor has been described fully elsewhere[1], the following is but a brief outline of its operation. The types of distortion for which both the human and the automatic monitor must listen are as follows :—

1. Noise, including cross talk.
2. Frequency response distortion.
3. Harmonic or overload distortion.
4. Changes in transmission equivalent or, of course, a complete disconnection.

The automatic monitor measures the above distortions as a change in volume. Noise may be detected as an appreciable increase in amplitude when programme is of comparable volume. Defects in frequency

[1] "Carrier Frequency Control: Automatic System for Unattended Transmitting Stations," by J. C. Gallagher, *B.B.C. Quarterly*, Vol. IV, No. 4, Winter 1949-50.

"The Design of Automatic Equipment for Programme Routing and Sequential Monitoring," by H. D. M. Ellis and J. C. Taylor, *B.B.C. Quarterley*, Vol. IV, No. 4, Winter 1951-52.

"The Automatic Monitoring of Broadcast Programmes," by H. B. Rantzen, F. A. Peachey and C. Gunn-Russell, *Proc. I.E.E.*, Vol. 98, Part III, No. 55, September 1951.

"The Broad Principles in the Design of Automatic Monitors," by F. A. Peachey, H. B. Rantzen and C. Gunn-Russell, *Electronic Engineering*, January 1951.

response and transmission equivalent obviously show up in the same way. Harmonic distortion is usually caused by the compression of the signal in an overloaded valve stage; this again may be detected as a volume change.

In any part of the programme chain, phase distortion is likely to affect the waveform of the electrical signal, but as the human monitor will not normally hear this change the automatic monitor should ignore it. Similarly, small amounts of frequency response distortion at the extremes of the band or even quite high levels of very low frequency noise, which are unimportant owing to aural sensitivity, must not affect the automatic monitor.

Automatic Monitor

A schematic diagram of the automatic monitor is shown in Fig. 3. Both the "reference" and the "compared" programmes are fed into identical units called volume folding and limiting amplifiers. These v.f.l. amplifiers have a complex function to perform. They are provided with a non-linear input-output characteristic so that there is a degree of equality in the measurement of distortion at both high and low volumes of programme signal. An aural sensitivity "weighting" network is introduced into the circuit of each of them so that the sensitivity of the equipment to signal distortion may approximate to aural sensitivity. At the output of the v.f.l. amplifier the signal, so processed, is rectified and integrated in an RC network of the appropriate time constants. In this way the transients and steep fronts of programme signal are smoothed out and the unwanted effects of phase distortion are eliminated. The outputs from the two v.f.l. amplifiers are fed in series opposition to a differential detector, which indicates when the two outputs differ by more than a predetermined amount.

As the checking of technical quality of transmission over the link being automatically monitored is entirely dependent on this equipment, reliability is of primary importance. Also, it is essential that the automatic equipment should be as far as possible self-supporting and should not require elaborate routine maintenance. For these reasons the equipment is arranged to sound its own alarm, when, as a result of some internal fault, it fails to provide proper monitoring.

At Daventry the automatic monitors associated with each transmitter are required to take executive action. Of course this should not be taken if the "operation" of the monitor is due to its own internal fault. Automatic means are therefore provided for the monitor to prove its own circuits before such action is taken. For this purpose a testing unit has been added to the normal monitor equipment. This unit also provides a means of integrating the normal monitor alarms so that executive action is not taken unless the operations are sufficiently frequent or persistent.

The equipment is arranged so that the first transmitter to be proved faulty is shut down by its own monitor. In the event of the second transmitter becoming faulty, its associated monitor is prevented from taking executive action, and instead an alarm is given in the central control room. This latter feature means that the closing down of the second transmitter is left to the discretion of an engineer. Obviously his decision will be tempered by the knowledge that he will be closing down the whole service, and he will do this only when the distortion is most severe.

The third automatic monitor shown in Fig 1 is provided to watch the overall system. In addition to the transmitters that are already checked individually, it monitors the common input equipment, the one and a half miles of feeder line to the aerial and the aerial itself.

Each transmitter is a complete unit containing all the circuits which are necessary for it to be locally operated from its own manual controls. Additional control circuits external to the transmitters are provided for starting and stopping the transmitters from the remote point, and for locally selecting one or other of the transmitters if the need arises. Operation of an overload protection device or of an automatic monitor removes the h.t. supply from the appropriate transmitter, and after fifteen seconds the lack of feed on its final amplifier is used to initiate the switching of the serviceable transmitter. At the same time all other supplies are removed from the faulty transmitter.

There are three methods of operating the equipment: (*a*) transmitters on manual control without automatic features or remote control facilities; (*b*) transmitters on manual control but incorporating automatic re-selection in the event of an overload; (*c*) transmitters remotely controlled and fully automatic. A three-position switch provides the means of selecting the method. The switch can be changed from its normal position (*c*) whilst the transmitter is running. This facilitates fault location and servicing without interruption to transmission.

During the six months that this equipment has been in operation, it has proved itself capable of maintaining the highest possible standards of fidelity coupled with the very minimum of programme interruption.

TAPE RESISTORS

IN our February, 1952, issue we described an adhesive resistor developed by the American Bureau of Standards for use on printed circuits. It had one apparent drawback, as after fixing in position the resistor had to be "cured" at about 300 deg C and only certain base materials would stand this high temperature.

It is reported in the Bureau's *Technical News Bulletin* for July, 1952, that these tape resistors can now be precured and secured in position on the printed circuits by either soldering or spot-welding.

The pre-cured resistor is made by sandwiching short metal lugs, or wires, between two pieces of uncured adhesive tape and then "firing" to process the resistor and bond the parts securely together.

A pre-cured resistor of this kind is about 1½ in long and has the appearance shown in the accompanying illustration.

Pre-cured tape resistor for use on printed circuits. (Photo courtesy Technical News Bulletin.)

BEATS

Visible and Audible Effects When Two Frequencies are Combined

By "CATHODE RAY"

LIKE everybody else who ever tries to explain the principles of radio to beginners, I knew that what is called beating or heterodyning is one of the subjects where trouble can be confidently expected. But until an attentive reader fired a burst of well-aimed questions on it I hadn't realized just how many difficulties it can present to the enquiring mind. It is easy enough to look at pictures like Fig. 1 and visualize currents or voltages varying in that sort of way. There is no difficulty in seeing that (a) and (b) have the same frequency but different amplitudes, whereas (b) and (c) have the same amplitude but different frequencies. These ideas are quite easy to grasp, using this type of diagram. With a little more effort, any reasonably intelligent and persevering pupil can learn to think of the same ideas in terms of rotating vectors, or even sin and cos. The trouble begins when two of these simple alternating signals are combined and their frequencies are not the same. Since combinations of this kind are at the bottom of so much of radio, it is worth trying to get a firm grasp of the principles.

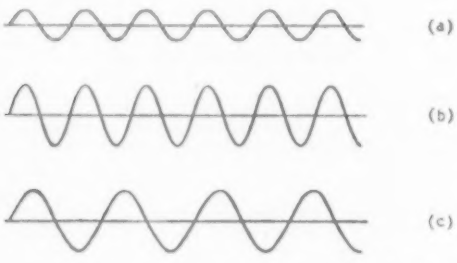


Fig. 1. The most popular way of depicting alternating signals. Differences in amplitude—e.g. (a) and (b)—and frequency—(b) and (c)—show clearly.

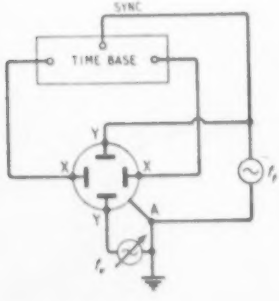


Fig. 2. Recommended arrangement of apparatus for showing the wave pictures Figs 3-10. Note that the variable-frequency signal is connected so as not to influence the time-base frequency.

Most of the difficulty, I think, is that our forms of expression let us down. One can, of course, add any two—or indeed any number—of Fig. 1 type waveforms point by point to get a picture of a composite signal; but to get anything like an accurate picture the work is so tedious that few pupils are persevering enough to do it. Especially as the shape of the result is affected so much by slight differences in relative frequency and amplitude that one really has to draw dozens of different combinations to see clearly how it depends on these things. Vector diagrams require a certain amount of effort to follow even when all the vectors have the same frequency so that they keep the same relative positions, and the diagram can be imagined to be rotating as a whole; but when the frequencies are different, making the vectors rotate at different speeds, it becomes too much of a strain. So the instructor generally falls back on trigonometry, which shuts out all non-trigonometrical aspirants, and even if one has learned the gentle art of manipulating the sin and cos, the manipulations don't give one much of a picture of what is actually happening to the signal voltage and waveform.

The best thing, without a doubt, is to connect the required number of signal generators to an oscilloscope and watch results. Two generators are enough for a start, and since it is only the relative frequency that matters, one of them need only give a fixed frequency and amplitude, the other being variable in both these respects. Unless the set-up is rather carefully thought out, however, it will only make confusion worse confounded by showing an infinite variety of complicated and beautiful patterns, which, however much they may excite admiration, fail to clarify the particular issue under consideration. To enable the waveform picture to be seen clearly, it is desirable for it to be made to stand still, which calls for synchronization. The provision for this in most oscilloscopes is an adjustable connection between the "work" (i.e., the signal being studied, applied to the Y plates) and the time-base generator. This may function quite nicely with a single signal, but when beat effects are obtained, causing fluctuating amplitude, it does not. The time base should be locked to the fixed-frequency (f_v) signal only, and not affected by the other. Perhaps the simplest way of achieving both these requirements is to connect the fixed signal generator to one Y plate and to "Sync," and the other to the other Y plate, as in Fig. 2.* This can't be done with a double-beam tube, or an oscilloscope in which one Y plate is firmly attached to a shift control and is not accessible, so one would have to think of something else, such as using magnetic deflection for the variable generator. Another thing is that the

* The symbol for a variable-frequency generator is not in BS.530, for I have just this moment invented it, but it seems the obvious one to use.

variable frequency (f_v) should be very precisely adjustable. And neither frequency should have any appreciable tendency to drift. Lastly, to avoid unnecessarily complicating the issue, both waveforms should be good sine waves, and, of course, free from disturbance by 50 c/s mains or anything else.

If one is lucky enough to have apparatus of the foregoing description to play about with, then the best thing is to spend half an hour or more with it, adjusting the time base to give, say, 10 cycles of f_f on the screen and then raising f_v gradually from lowest to highest. The effect of making the amplitude of f_v equal to, greater or less than f_f should also be noted, but it is best to go into this after the results of varying frequency with a fixed one-to-one amplitude ratio have been thoroughly digested. One thing at a time.

Since the odds are probably against any given reader having access to the aforementioned apparatus for the purpose of first-hand study, I shall try to do my best for him by giving a running commentary, aided by a few stills; and in particular to answer the pertinent questions asked by the reader who was responsible for starting this line of thought.

For the sake of example I shall assume that f_f is 500 c/s and f_v is raised slowly from 50 to 5,000 c/s, and first that the signals are equal in amplitude. But one can easily start in imagination at zero frequency. If a constant positive voltage is added to the f_f signal (or any other) its effect is to raise the whole thing bodily; if negative, to lower it—assuming the conventional directions of + and −. These effects are shown by the upper and lower wavy lines in Fig. 3. Since in our case the added voltage is equal to the peak amplitude of the original signal, the negative peaks of the upper trace and the positive peaks of the lower one just touch the centre line.

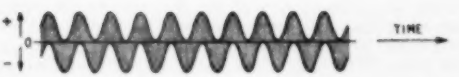


Fig. 3. The two wavy lines represent what is seen of the fixed-frequency (f_f) signal; the top one when displaced by a constant positive voltage equal to its peak voltage, and the bottom one when the constant voltage is negative. If an alternating voltage is substituted for the constant one, the combined voltage varies within the shaded area.

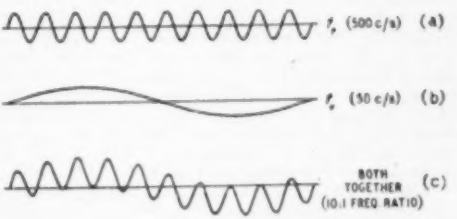


Fig. 4. "Waved waves" produced when the ratio $f_f : f_v$ is large. There is no perceptible variation in amplitude of the signal when the other is added.

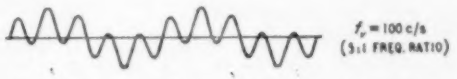


Fig. 5. The effect on Fig. 4(c) when f_v is doubled

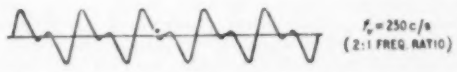


Fig. 6. Here f_v is increased to 250 c/s. While still clearly a waved wave it now begins to show beats.

Waved Waves

When now the added signal is alternating, *at any frequency*, obviously it alternately raises and lowers the f_f signal between the same limits. So all the possible traces obtainable as f_v is varied occupy the shaded area. In general, each trace ends (and therefore the next one begins) at a different level, so successive traces don't coincide and there are so many different ones seen at once that the area between the upper and lower limits is filled with them and Fig. 3 does represent pretty well what one sees. But every now and then, as f_v is varied, a frequency turns up that gives an exact number of cycles during the time occupied by 10 cycles of f_f, and then the combination pattern is stationary.

At $f_v = 50$ c/s, for example, the separate and combined signals look like Fig. 4. The combination (c) might well be called a "waved wave," like the coiled-coil filaments in domestic lamps. This, of course, is quite an easy case to plot by adding instantaneous amplitudes of (a) and (b) on paper. Even the vector diagram is not impossible to visualize—one rapidly rotating vector (representing f_f) alternately raised and lowered by a slowly rotating one (representing f_v) "in series."

As f_v is increased, the f_f wave is waved more rapidly. At 100 c/s it does it twice during each time-base sweep, as in Fig. 5. The waved wave action is quite easy to follow. But it doesn't seem to have anything to do with the production of beats—the alternate waxing and waning of sound that one gets when notes of two nearly equal frequencies are heard together. My enquirer had read in a textbook that a beat is produced "when two neighbouring frequencies are combined," and he asks how close is "near"? Where and how do they change over from being near to being not near? As is well known, the frequency of the beats is equal to the difference between the frequencies of the notes producing them; so one might say that so far in our experiment the beat frequency (450 c/s in Fig. 4, and 400 c/s in Fig. 5) is too high for the ear to distinguish as increases and decreases in loudness. True, but oughtn't one to be able to *see* it on the oscilloscope? Actually it just looks as if the f_f signal is being pushed up and down as a whole, without affecting its amplitude at all. Which is exactly what one would expect. However, as f_v is increased, so that there are fewer and fewer cycles of f_f to each cycle of f_v, it becomes clearer that the waveform of f_f is being distorted. By the time we have brought up f_v to 250 c/s, so that there are only two cycles of f_f to each one of f_v, signs of beating are beginning to be unmistakable on the screen (Fig. 6) even though there is not yet any trace of them audibly. In fact, although there is no sudden transition between the up-and-down waving at constant amplitude, as in Fig. 4(c), and the waxing and waning of amplitude

with no up-and-down effect, characteristic of beats, the 2:1 frequency ratio pictured in Fig. 6 can be regarded as the transition, at which both effects can be seen. The original f_t signal is clearly pushed up and down five times in every 10 of its cycles, and at the same time the cycles are alternately large and small. In Fig. 6 (which is only one of the many patterns obtainable with this frequency ratio) the beat effect is clearer if one starts comparing the sizes of cycles *after* the first half-cycle. A slight phase shift gives Fig. 7, where again both waving and beating can be discerned.

From 250 c/s up to 500 c/s (or, more generally, from 2:1 to 1:1 frequency ratio) beating displaces waving as the dominating effect. At $f_s = 400$ c/s (Fig. 8), the cycles obviously wax and wane twice during the period (i.e., at frequency $100 \text{ c/s} = f_t - f_s$); but they all come more or less equally above and below the base line. Theoretically, the 500 c/s waveform should wave up and down 400 times per second, but it is difficult to visualize this! If you want to know what it looks like, see Fig. 8.

When f_s is brought very near f_t the beating becomes slow enough to hear clearly, but too slow to see clearly on such a rapid sweep. If you slow it down enough to get more cycles in, you will be able to produce pictures like Fig. 9. Finally, when $f_s = f_t$, which in other connections is called "tuning to zero beat," there is neither beating nor waving effect. The picture has the same shape as originally, Fig. 4(a), except that if the other signal is in phase its amplitude will be greater, and if in opposite phase, less. If exactly opposite—and equal—the two will cancel out to give nothing at all. The slightest change of either frequency causes the phase to shift slowly round, making the signal amplitude alternately increase to double and decrease to zero. In other words, a very slow beat. This is another case where the vector diagram is not too hard to visualize—the sum of two vectors rotating at nearly the same rate, so that they alternately open out and close like the case and blade of a pen-knife—except that the blade swings right round instead of shutting the same way as it opened.

Effect of Frequency Ratio

Recapitulating so far, then, we find that when the frequency ratio is large the waving effect dominates, and when it approaches 1:1 the beating effect dominates; and the cross-over can be said to occur at 2:1. This is quite reasonable if you come to think of it, for with a large frequency ratio (e.g., Fig. 4) the low-frequency signal changes very little during a single cycle of the high frequency, so it pushes both of the half-cycles the same way—upward or downward—and the amplitude of the cycle is not affected. But when the two frequencies are nearly equal the positive and negative half-cycles of both signals nearly coincide, and the second signal pushes the half-cycles of the first in opposite directions, affecting the amplitude of the cycle. As the phase swings slowly in and out the amplitude is made to wax and wane. When the frequency ratio is 2:1, neither of these conditions prevails, and the result is a rather complicated mixture of a little of each.

There is no need to spend much time over what happens when f_s is raised from 500 to 5,000 c/s. It is a repetition of 50 to 500 in the inverse order, beginning with slow beats and ending with waved waves. The only difference is that the constant time-base frequency

Fig. 7. The same as Fig. 6 except for a phase shift between the two component signals.

Fig. 8. At $f_s = 400$ c/s, beats are much closer than waved waviness.

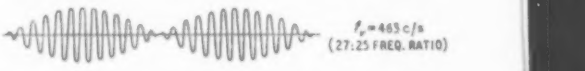


Fig. 9. When f_s is nearly equal to f_t the time base has to be slowed down to show the beats clearly.

is now locked to the *lower* of the two frequencies, so the number of cycles visible continually increases. At 5,000 c/s the frequency ratio to 500 is the same as 500 to 50, so the picture is the same as Fig. 4(c), except that it is repeated ten times over within the same base line, as in Fig. 10.

Which Frequency Predominates ?

Having got so far, we can consider another of my enquirer's questions. He had just been shown that the result of adding 400 c/s to 500 c/s (Fig. 8) was to make the 500 c/s signal vary cyclically in amplitude (i.e., beat) at the difference frequency, viz., 100 c/s. Whereupon he asked, why not *400* c/s beating at 100 c/s ? This is a fair question. Seeing that 500 c/s and 400 c/s are equally present, why choose one more than the other ? Which is "the" frequency ? But it is not the sort of question one cares to get without notice. I'm not sure that even now I could give a simple answer to it. It depends on how one reckons frequency. If one starts to vary the amplitude ratio, making one signal much stronger than the other, then it is soon seen that the frequency, *reckoned by the number of visible up-and-down waves*, is (as one would expect) that of the stronger. But if one reckons by listening to it, one may not be quite so sure. Some musical instruments have harmonics stronger than the fundamental. But to a musical ear "the" frequency is that of the fundamental, not of the strongest component.

Looking at Fig. 6 or 7, would you say there were 5 cycles or 10 ? If you count every up-and-down you would find 10. But others would argue that this waveform shows 5 cycles of a 250 c/s fundamental with a strong (actually 100 per cent) second harmonic. Or, if you reckoned the frequency by the time period of the large half-cycles, you would say there were 7½ cycles. So it seems to be largely a matter of choice or definition. It is quite fascinating to get a visible beat on the 'scope between, say, 500 and 600 c/s, and vary the amplitude of the 600 c/s signal. When it is relatively small, there are clearly 10 cycles, of various amplitudes. But at a certain amplitude ratio, not far from 1:1, one suddenly becomes aware that two extra cycles have somehow insinuated themselves into the picture, at the points where the amplitude is at a minimum. But although each consists of a complete

up-and-down, reckoned by time they are only half-cycles, like the half-pace a soldier takes to get into step if he is out of it.

By increasing the 250 c/s amplitude in Fig. 6 the small cycles can be made to disappear, remaining as a distortion of the 250 c/s waveform; but the ratio has to be more than 2:1 for this to happen. In Fig. 7 it would have to be larger still. Obviously the 50 c/s component in Fig. 4(c) would have to be expanded enormously to iron out the 500 c/s ripple into a mere distortion. On the other hand, when the frequencies are nearly equal, the lower frequency signal amplitude need only be increased very slightly. The reason is that the slope of the wave is proportional to frequency as well as amplitude, so a ripple of a high-frequency component can only be cancelled out by the opposite slope of the low-frequency component if its amplitude is greater.

Beat-frequency Signal

So far we have been considering pure addition. In other words, we have been assuming that the circuit in which the two signals are combined is linear; i.e., its impedance is the same at all amplitudes, so that the presence of one signal does not make any difference to it for the other. The Law of Superposition holds good, and Ohm's Law, and altogether everything is very straightforward and law-abiding. No new frequencies are created. Or, more correctly, the combinations contain no signals of frequencies different from those put in. It is the difference between these two statements that causes confusion in the minds of beginners. This particular confusion is so well known that I need hardly do more than mention it. The point is that whereas it would be reasonable to say that in the Fig. 8 condition a new frequency is created—the beat frequency, 100 c/s—there is no actual signal of that frequency present. It is only the frequency at which the amplitude of the combination waxes and wanes. *There is no 100 c/s signal.* When the beat frequency is very small, say, 2 c/s, there is no difficulty in hearing it, *as a rate of beating*, though a 2 c/s signal, even if present, would be far too low in frequency to be audible.

If one wants to produce an actual signal of a different frequency from any that one happens to have—as for example in a superhet—the available frequencies have to be combined in some non-linear circuit, such as a rectifier; or the amplitude of one signal has to be able to affect the other in some other way, indirectly, as in a frequency-changer valve. Either way, some degree of multiplying action is obtained. This is easiest to see in the frequency-changer valve. One of the signals is applied to a control grid, and the output obtained depends on the "slope" of the valve, g_m. In a pentode type of valve, in fact, the output amplitude is very nearly proportional to g_m, so that g_m appears as a factor. If now the other signal, of a different frequency, is applied to another grid that controls the slope according to the voltage applied, then the instantaneous signal voltage of this other signal appears as a factor in g_m. Therefore, bringing these two facts together, it appears as a factor in the output voltage of the first signal. In other words, the output includes the product of both signal voltages, multiplied together. Since the resistance of a notably non-linear device, such as a rectifier, is more or less proportional to the applied signal voltage or current, a multiplying action occurs there too. When there is non-linearity of any kind, new frequencies are produced—actual signals that one can tune in and use. These frequencies depend on the nature of the non-linearity, but they generally include the sum and difference of the input frequencies, and multiples of them—harmonics. The purpose of looking on the non-linearity as multiplication is that it helps one to work things out mathematically. I'm not going into this in great detail, because there is no room, and it is not the subject of this article, but I did deal with it at some length in the July, 1948, issue, and if that is too long ago there are books that explain it to anyone who doesn't know it already. My only object in summarizing it now is to comment on my enquirer's trump card of a question.

He referred me to two diagrams in the book *Foundations of Wireless*, 4th edition. (In the current 5th edition parts of these diagrams are not included.) The first was Fig. 85, on p. 122, which says just what I do here in Fig. 4, that if you add (a) to (b) you get (c). It also says that if you *multiply* (a) by (b) —or rather (b) plus a constant voltage equal to its peak value—you get something like Fig. 11 here. A little consideration should show that this is quite true. The second reference was Fig. 162, on p. 246, which says that if you *multiply* (a) by (b) in Fig. 12 here you get a waved wave (c) and if you *add* them you get a beat (d). Addition and multiplication seem to have changed places, judging by the results.

Although I was not altogether unacquainted with *Foundations of Wireless*, I had to admit that I had never compared these two diagrams nor noticed that they seem to contradict one another. But do they? We have already seen how adding two lots of sine

Fig. 10. With $f_a = 5{,}000$, the frequency ratio is the same as in Fig. 4, and the picture the same as in Fig. 4(c) except that everything happens 10 times as often.

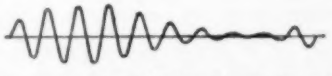


Fig. 11. The result of multiplying (a) and (b) in Fig. 4.

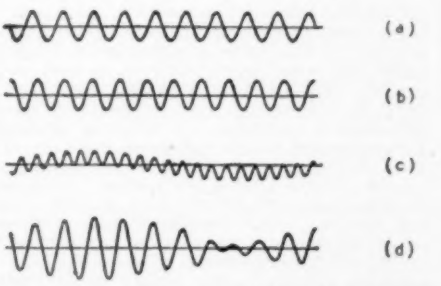


Fig. 12. When (a) and (b) are multiplied, the result is as at (c); when added, as at (d). Compare Figs. 4(c) and 11.

waves can give either waved waves or beats, depending on the ratio of frequencies. So would it be very surprising if multiplying two lots of sine waves began by giving beats and gradually changed over to waved waves as the frequencies were made more nearly equal? To the trigonometrician it certainly would not be surprising because he would know that when you multiply one sine by another—or rather a cosine, which is the same thing shifted quarter of a cycle—you get one sine *added* to another. So no wonder! This is the mathematical expression of the well-known fact, already mentioned, that the effect of a non-linear or multiplying device on two lots of sine waves is to produce signals of other frequencies, which, of course, add together to give the results already studied. The clue to the mystery is that although (a) in Fig. 12 is the same as in Fig. 4, (b) is not. But the *difference* between (a) and (b) in Fig. 12 is the same as (b) in Fig. 4; and as a signal having this difference frequency is produced by a non-linear device, (a) *plus* (b)—and hence (a)—in Fig. 4 is produced by (a) *times* (b) in Fig. 12. The difference frequency produced by two nearly equal frequencies such as in Fig. 12 is a relatively low frequency, as Fig. 4(b). In addition there is a sum frequency which, being nearly double the frequency of Fig. 12(a) or (b), gives the higher-frequency ripple of Fig. 12(c). When multiplied frequencies are very different, as in Fig. 4(a) and (b), the difference frequency is nearly as high as the higher frequency, so the difference between these output components is small, which accounts for the slow beat (Fig. 11) yielded by the two together. Actually Fig. 11 (formed by multiplying very different frequencies) has not quite the same form as say Fig. 9 (formed by adding nearly equal frequencies). The outline or "envelope" of all the positive tips in Fig. 9 traces half-cycles of sine waves, whereas in Fig. 11 the presence of a sum-frequency signal smooths the envelope out into a complete sine wave. This could be seen better if the "carrier-wave" frequency were higher.

Fig. 13. A simple mechanical analogy for demonstrating the production of beats.

Finally, if you have no oscilloscope, etc., but would nevertheless like a little instructive amusement, you might care to try the time-honoured experiment shown in Fig. 13. Tie a piece of string between two fixed points and hang two others from it with weights attached. W_1 is a fairly heavy weight and when set swinging at right angles to the horizontal string it will move it backwards and forwards sinusoidally. This movement will be superimposed on that of the other pendulum, which should be a different length, so as to swing at a different frequency. As its weight is comparatively light, it won't have much effect on the first pendulum. The combined motion of W_2 traces out a beat, the frequency of which can be altered by altering the difference between the frequencies of the pendulum. Actually the analogy is not perfect, because there is coupling between W_1 and W_2, but it does very strikingly demonstrate beating and (if the lengths are made sufficiently different) waved waves. I have just obtained a beautiful mechanical reproduction of Fig. 6.

Marine Radar Aerials

AT a recent conference in London between representatives of Government research establishments and British manufacturers, a comprehensive review of the present state of our knowledge of the theoretical basis of centimetric beam aerial design and its practical interpretation was contained in thirteen main papers and the subsequent discussions.

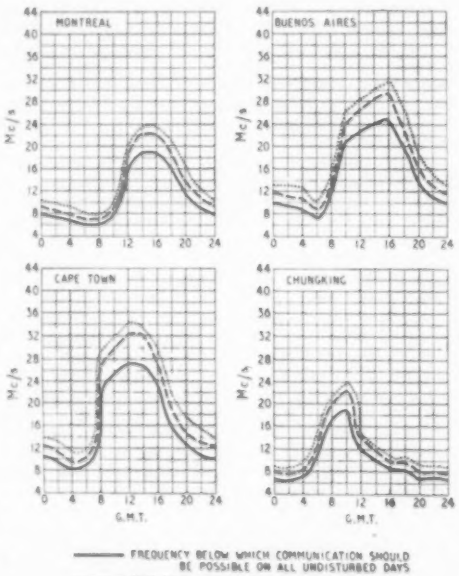
The proceedings have now been published by H.M. Stationery Office and form a concise reference manual which will prove of value not only to professional engineers because of the extensive bibliographies, but also to students who will find the essential simplicity and directness of the many diagrams of great help in following the principles discussed in the text. The full title is "Proceedings of a Conference on Centimetric Aerials for Marine Navigational Radar," and the price is 15s (16s by post), or in U.S.A. $3.50, postage included.

Short-wave Conditions

Predictions for November

THE full-line curves given here indicate the highest frequencies likely to be usable at any time of the day or night for reliable communications over four long-distance paths from this country during November.

Broken-line curves give the highest frequencies that will sustain a partial service throughout the same period.


MONTREAL
BUENOS AIRES
CAPE TOWN
CHUNGKING
Mc/s
G.M.T.
FREQUENCY BELOW WHICH COMMUNICATION SHOULD BE POSSIBLE ON ALL UNDISTURBED DAYS
PREDICTED AVERAGE MAXIMUM USABLE FREQUENCY
FREQUENCY BELOW WHICH COMMUNICATION SHOULD BE POSSIBLE FOR 25% OF THE TOTAL TIME

THE "BELLING-LEE" PAGE

Providing technical information, service and advice in relation to our products and the suppression of electrical interference

Polar Diagrams

We have been taken to task for the wording of the paragraph under this heading in the October issue. We accept the criticism. What we should have said was: The term "Polar Diagram" is apt to mislead a non-mathematical reader into thinking that it has something to do with geographical poles, particularly when thinking about the directional characteristics of an aerial. It makes sense to a mathematician who is plotting his response on circular graph paper (cartesian co-ordinates). This is why we prefer the term "directional response," since it means what it says.

"Belling-Lee" Bulletin

For the past few years we have been inundated with applications for reprints of this page. These have been made available simply as reprints stapled together. For the Radio Show, we produced an 8-page newspaper-style publication based on these "Wireless World" pages. They have been carefully edited and brought up to date. Copies are available to any reader who cares to apply.

Junior "Multirod" Three-Element Director Reflector Array

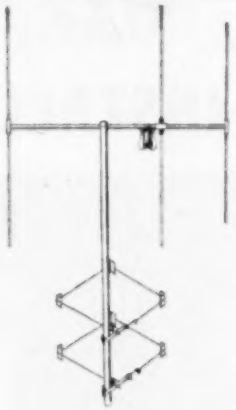
We have now introduced a new three-element aerial comprising dipole, director and reflector, whose performance falls mid-way between that of a "Multirod" and that of a "Senior" "H" ½-wave spaced aerial. This will be known as the Junior "Multirod." We have introduced this new aerial primarily in recognition of the growing need for economical installations in fringe areas, especially in country localities, where it will be found invaluable. In town locations, where interference levels may be extremely high, the well-known "Belling-Lee" "Multirod" four-element array is still the best for the job.

At £11 15 0 (Channel 1) it is five pounds cheaper than a Senior "Multirod" and three pounds dearer than a Senior "H."

A New Head Amplifier

The important factor in television reception is to achieve the highest possible signal-to-noise ratio. Amplification itself is no problem, but the limit to long-distance reception is reached when the random noise at the set input exceeds a certain figure.

A second limit is set by the noise generated in the first stage of the receiver, which means that signals, even if they are noise-free, have to be above a certain limit to give satisfactory results.



Junior "Multirod" Three-Element Array with Mast Head Amplifier fitted to cross-arm.

Thus, for extreme fringework, a pre-amplifier which contributes as little noise as possible itself, is required to be placed in a position where it receives the highest available signal from the aerial and will give sufficient amplification to feed the actual receiver with a signal level which ensures entertainment value. The illustration above shows the amplifier fitted to the cross-arm of the Junior "Multirod."

As feeder cables introduce appreciable losses, the ideal position for an amplifier of this type is within a few feet of the aerial, and in fact our particular amplifier is designed to be fitted to the cross-arm. Needless to say the aerial unit is very adequately sealed against the weather.

The amplifier consists of a single stage push-pull grounded grid triode circuit, with a power gain (from input to output terminal) of 8 db.

The amplifier has an input impedance of 30-ohm and an output impedance of 80-ohm, thus matching a "Multirod" or a Junior "Multirod." Connection to the lower power supply or receiver unit and thence to the receiver is made by 80-ohm semi-air-spaced coaxial cable. No additional leads are required, since this feeder also carries the low voltage power supply to the amplifier at the masthead.

Book Review

"Radio Interference Suppression," by G. L. Stephens, A.M.I.E.E. Published for "Wireless World" by Iliffe & Sons Ltd., Dorset House, Stamford Street, S.E.1. Price 10s. 6d. net (plus 5d. postage).

Probably one of the most inaccessible subjects in book publications is that of radio interference, and for that reason alone this book should appeal strongly to radio dealers. It is a revision of an earlier book under the same title which has become out-dated by the progress of electrical development and the growth in the popularity of television reception.

Throughout the book the author has borne in mind the influence of television receivers on the subject of interference not only when television is the victim, but also when it is the offender. His style is discoursive and practical, and makes easy reading. The treatment is qualitative, almost entirely unmathematical, and is adequately illustrated with diagrams and photographs.

The book opens with what might be termed the theory of interference; how it originates, and the principles of suppression. These sections are followed by others on the practical application of suppression devices to cars, electric motors, rotary convertors, various lighting systems, medical and industrial apparatus, etc., and a complete section on marine applications. Then the requirements of suppressor components are explained.

Other chapters describe the methods of locating an interference source and suppression at the receiving end. Appendices deal with interference measurement, the Wireless Telegraphy Act, Part Two, and screened rooms.

Although this book is described as a second edition of the original book by G. W. Ingram, it has been entirely rewritten by the present author, who is with Belling & Lee Ltd., and is an authority on the subject with a great deal of practical experience behind him. The book has 132 pages, and there are 65 illustrations.

We are indebted to the Editor of "Wireless and Electrical Trader" for permission to reprint this review.

Written Sept. 24th, 1952

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MARCONI TELEVISION

VENEZUELA INSTALLS MARCONI

Dr. Rodriguez Jimenez, Venezuelan Consul-General in London, at the signing of a contract in the London consulate on 9th July, 1952, to provide British equipment for a television service at Caracas.

The equipment for the Caracas Television Station, sponsored by "Televisa," includes:

- 5 kW vision transmitter
- 3 kW sound transmitter
- Associated aerial system
- Complete studio installation
- Complete mobile O/B television unit, with two camera channels and micro-wave links

MARCONI

television transmitting equipment

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LETTERS TO THE EDITOR

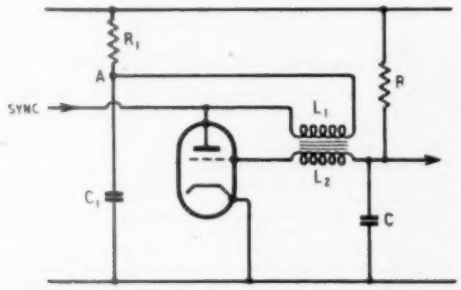
The Editor does not necessarily endorse the opinions expressed by his correspondents

"Faulty Interlacing"

G. N. PATCHETT'S article in the July and August issues is a notable contribution to interlacing technique. This is not so much because of the particular circuit which he advocates in his Fig. 20 (there are other ways of achieving the required result) as because of the way in which he has established the principles. As a result, certain peculiar effects which have been noted experimentally can now be satisfactorily explained.

When using trains of frame pulses which are identical in successive frames except at their ends, like those in Patchett's Fig. 9, it has been found that interlacing is not obtained when the blocking oscillator has a charging circuit at both grid and anode. On the other hand, perfect interlace is obtained when it has one charging circuit only, at the grid. In both cases, the sync pulses are applied to the anode.

Referring to the accompanying figure, if flyback is completed and the valve rendered non-conductive before the



end of the pulse train, the end of the train can have no appreciable direct effect on the charge on C. Pulse currents flowing in L_1 can induce e.m.fs in L_2 but, because C is normally very large compared with the grid-cathode capacitance of the valve, they can affect the charge on C very little indeed.

The currents flow directly into C_1, however, with an effect dependent on its capacitance. If it is very large, so that point A is at a substantially constant potential, they affect the performance negligibly. If C_1 is small, however, as it must be if a saw-tooth is to be developed on the anode, the precise charge on C, at the start of a scan is affected appreciably by the pulse currents and differently on successive frames. The charge at the end of the scan is dependent on the charge at the beginning and is also affected. During flyback, grid and anode currents flow simultaneously and the magnitude of each is affected by the magnitude of the other. The valve therefore couples C and C_1 during the flyback and the variations in charge on C_1 between successive frames affect the grid waveform also.

I noticed this effect some years ago when developing the *Wireless World* Television Receiver and I utilized the blocking oscillator to generate a grid saw-tooth, for the very good reason that I found it to be the only way of obtaining good interlacing. A separator giving identical pulse trains on all frames had not then been developed. Patchett's article now provides the reason for this behaviour which has always seemed somewhat anomalous.

As a result of Patchett's work and my own experience, I would formulate the first requirement for interlacing as follows:—

It is a necessary, but not a sufficient, condition for interlacing that the frame synchronizing pulses applied to the saw-tooth generator shall be identical in successive frames *for such time as they are capable of influencing the generator.*

The italicized clause covers the case mentioned above and is worth stressing. If the generator is not affected by differences in the ends of the pulse trains, it is clearly not worth while using a special separator which makes them alike, especially if it is inconvenient to do so. Provided that flyback is completed before the ends of the pulse trains the blocking oscillator with the saw-tooth developed on the grid, the anode fed from a constant-voltage source and negative-going sync pulses fed to the anode is one such circuit. Another should be any form of blocking oscillator of sufficiently rapid flyback with the sync pulses injected by a third winding on the transformer.

London, N.14. W. T. COCKING.

Television Bandwidth

WITH reference to W. MacLanachan's letter in your October issue, I should be glad to have an opportunity of confirming that the transmissions radiated from all the B.B.C. television stations include video frequencies up to 3 Mc/s. There is no intention deliberately to restrict the bandwidth of these transmissions to some lower figure within a 3-Mc/s bandwidth such as 2.75 Mc/s.

It is the B.B.C.'s aim not only to maintain but to improve the quality of its television transmissions, since the 405-line system has not yet been exploited to its fullest potentialities.

F. C. McLEAN,
Deputy Chief Engineer, B.B.C.

"R.F. Characteristics of Capacitors"

R. DAVIDSON is to be congratulated on his article in the August *Wireless World*, which should be of considerable value to both receiver and suppressor designers.

The specific use of the series resonance of a capacitor together with the parallel resonance of the complementary inductor for television band suppressors is of interest in so far as it is a departure from the conventional. Presumably the normal filter functions of L and C are replaced by a form of attenuator which may be resistive, capacitative or inductive in the region of resonance. Whilst mention is made of the useful bandwidth of the capacitor series resonance, nothing is said about the bandwidth of the coil impedance. One wonders, therefore, whether this is at all critical. A further question can be posed on the behaviour of the suppressor at frequencies higher than resonance, but within the frequency band over which suppression is required. Would the change from low-pass to high-pass configuration give rise to considerable worsening of the attenuation of noise voltage?

During certain experiments with the design of suppressors to cover the nominal frequency band 0.15 Mc/s—30 Mc/s I have noticed that some improvement can be obtained between 1 Mc/s and 3 Mc/s when using single terminal with earthed case capacitors, by taking the circuit to and from the capacitor as with the two-terminal connection shown by Mr. Davidson. The process is simple. It involves merely the removal of the flexible lead provided and careful soldering of the circuit wires to the stub connection left. The effect of the optimum earthing point of the metal case has not, however, been noticed, as the capacitors concerned are designed to seat completely in a metal clip, which forms the earth connection.

With reference to the bushing capacitors it seems that the author has said just enough to whet the appetite and too little to be of practical help. The transfer impedance

curve shown appears to represent the ideal, and the question of whether such results can be obtained under practical conditions; i.e., when the capacitors are mounted within the restricted compass of the average suppressor, remains unanswered.

It would be useful to learn the best method of mounting bushing capacitors to give the desired performance, and how the practical consideration of small areas of metal (the earth plane of a suppressor) can be related to the unspecified theoretical requirement.

From observation of test results it seems that when these capacitors are mounted on small areas the parallel resonance peaks are often of a magnitude such as to lessen considerably the suppression obtained about 10 Mc/s. This may well be a function of the mounting.

Perhaps Mr. Davidson could offer his advice on these points, as an expensive bushing capacitor, which over a nominal frequency range of 10 to 1 (10 Mc/s—100 Mc/s) offers an impedance of many ohms, rather than a fraction of an ohm, is surely wasted. Of equal importance, a soundly conceived component may thus get an undeserved bad name.

Weymouth, Dorset. T. E. CLARKE.

Institution of Electronics

AS a regular reader of *Wireless World* for some years' standing I have always appreciated the "unbiased" ramblings of "Free Grid," but I cannot overlook the apparent ignorance which led him to write the last paragraph in his August article.

"Free Grid" has missed his opportunity of forming an Institution of Electronics by many years as the one already in existence was incorporated in 1920. However, if he can prove his knowledge and ability in this field he will be welcome as a member and may write M.Inst.E. (not M.I.Etron.E.) after his name.

Electronics is not a subject that any electrical engineer or electrician can tackle with ease. I worked on electronic apparatus before the word was coined, and I feel most strongly that electronics must be considered as a specialist subject and to do justice, an engineer must study it as such. DEREK J. SWADKIN, A.M.Inst.E.

London, S.E.2.

Phase Angle Ellipse

WITH reference to the note on p. 432 of the October issue of *Wireless World*, may I suggest a slight correction?

The simple method of estimating phase angle given is valid only when the *x* and *y* *total deflections* are equal; not the applied signal amplitudes as stated.

These deflections can be made equal if a continuous amplitude control is available for either signal. The modern fashion in oscilloscopes is, however, to provide stepped amplitude control, which means that it is often inconvenient to satisfy the necessary conditions.

Dundee. H. SUTCLIFFE.

Editorial Note.—It was assumed that the x- and y-deflection sensitivities of the tube were equal, but, as Mr. Sutcliffe points out, it would have been better to say "When voltages of the same frequency but differing in phase are applied to the x- and y-plates and have their amplitudes adjusted to produce equal deflections."

Amateur Operators

I CAN see no justification for publication of the letter from W. A. Richardson (October issue). Not only is the assumption that all 'phone operators are demons and all c.w. operators little blue-eyed boys incorrect, but grossly unfair. While in no way condoning the gibberish talked by some operators, may I point out that, if Mr. Richardson were able to read morse code, he would find an equally large percentage of c.w. contacts are "pattern" copy that serve no useful purpose other than confirmation of contact. Many operators, and I include myself in this category, would be completely hopeless in receiving perfect copy of code groups at 20 w.p.m. Only by sacrificing all experimental work in favour of operating could one approach this standard.

Amateur radio is a hobby, a very instructive one and one that in the event of an emergency can provide a backbone not of telegraphists but men capable of installing and maintaining radio *and radar* equipment. Only a very small number of amateurs were either wanted or used as telegraphists during the last war. Given a reasonable aptitude, an operator can be trained on a high-pressure basis in a few months, but even poor mechanics require years of training.

If Mr. Richardson is interested purely in operating, good instruction, a few reasonably free kc/s to work on and gear loaned free, may I commend to him one of the Services wireless reserves—not the amateur band where, at any rate in England, the largest percentage of stations are genuinely interested in technical advancement and progress.

RAYMOND M. EVANS,
Maidenhead, Berks. G3GGE

"Wireless World" Diary

WHAT is the empirical formula for calculating the output power required from an amplifier to fill a hall of a given size?

What is an ultra-high frequency?

What standard frequencies does Rugby transmit?

What is the circuit arrangement for suppressing a thermostat? or

What is the annual charge for an amateur transmitting licence?

It is answers to such questions as these that are readily available in the 80-page reference section of the *Wireless World* Diary, 1953, which gives in tabloid form the kind of technical and general information so often needed by radio men but seldom readily available.

Now in its 35th year of publication, the Diary—which gives a week to an opening—is a veritable mine of information, as will be appreciated from this selection from the contents of the reference section: abacs for estimating coil windings and circuit constants, addresses of radio organizations, s.w. and v.h.f. aerial design, circuit diagrams (including a 90-Mc/s converter and 2-watt a.c./d.c. amplifier), licence regulations, component coding and base connections for nearly 500 current valves selected from our "Radio Valve Data."

We are advised by our Publisher that all stocks of the Diary have been despatched to booksellers and newsagents, from whom copies are obtainable, price 6s 1½d (morocco leather) or 4s 7d (rexine) including purchase tax.

R/T HANDBOOK

ANOTHER publication into which is collated a considerable amount of information—but in this case exclusively on maritime radio—is the "Radiotelephony Handbook" issued by the Marconi International Marine Communication Co. for the benefit of users of marine radio-telephone equipment. Details are given of the services available in Europe, operating procedure and rates for radio-telephone calls to subscribers ashore via the land stations listed. Particulars (including geographical position, transmitting frequency and hours of service) are also given of the stations in the British Isles, Western Europe and the Mediterranean providing facilities for the exchange of radio-telephone calls to and from ships at sea within about 150 miles of the station.

WORLD OF WIRELESS

Problems of Specialization • R.S.G.B. Show • New London Television Transmitter • R.T.R.A. Apprenticeship Scheme

Specialization

THIS age of specialization has made it virtually impossible for a radio engineer to be an authority on any but a few of the aspects of radio or electronics on which he is closely engaged or which impinge upon his work.

This aftermath of the war, when, for reasons of security, engineers were segregated into "information-tight" groups, was criticized by W. E. Miller in his inaugural address as president of the British Institution of Radio Engineers. He contended that the Institution was not completely fulfilling one of its major objects—the dissemination of knowledge—if it provided only specialized high-level papers from which only a percentage of its members were able to profit. He proposed the publication of regular survey papers on every main branch of electronics so that those engaged in one aspect of the art can keep abreast of developments in radio and electronics generally.

The president suggested that whereas the specialist knows more and more about less and less, the "generalist"—to coin a word—knows less and less about more and more!

Mr. Miller recalled that when the Institution was formed in 1925, radio was just beginning to develop into an industry. Consequently, engineers started to specialize in the radio field, which although then allied with electrical engineering, nevertheless had its own individual technical problems. Now radio engineering has become recognized as a separate and distinct profession in which there are many specialized branches.

Phonetic Alphabets

WHEN the new phonetic alphabet for use in aeronautical radiotelephony was introduced by the International Civil Aviation Organization last November (see *W.W.*, December 1951, page 512) it was stated that although the new alphabet would normally be used by all Civil Aviation ground stations in this country, the old "Able-Baker" analogy would continue to be available to pilots on request until October 1st this year. It was hoped by the Ministry of Civil Aviation that pilots would use the new alphabet and so enable practical experience to be acquired. Little use has, however, been made of the I.C.A.O alphabet, but it has been decided that it should be brought into general aeronautical use in the U.K.

Amateur Radio Show

SIR IAN FRASER will officially open the R.S.G.B. sixth annual amateur radio exhibition at the Royal Hotel, Woburn Place, London, W.C.1 at 12 noon on November 26th. The exhibition, which is promised the support of a number of organizations who specialize in the provision of equipment, components, accessories and publications for amateurs, will be open daily from 11.0 to 9.0 on November 26th, 27th, 28th and 29th.

The R.S.G.B. will be exhibiting equipment constructed by its members and the British Amateur Television Club is to stage a demonstration of amateur television gear.

SIR IAN FRASER

Among those taking space at the exhibition are:—

Air Ministry, Automatic Coil Winder, Cosmocord, E.M.I. Sales and Service, Eastbind, English Electric, G.E.C., G.P.O., George Newnes, Goodmans, Panda Radio, Philpotts Metalworks, Salford Electrical Instruments, Siemens, Taylor Electrical Instrument, War Office, Westinghouse, *Wireless World* and *Wireless Engineer*.

Admission to the show is price 1s.

New A.P. Transmitter

ONE of the two 5-kW vision transmitters and associated 2-kW sound installations ordered by the B.B.C. from Marconi's in May is to be installed as a reserve at Alexandra Palace in time for the Coronation next year. As already announced, the other installation will be used at Sutton Coldfield.

Incidentally, the London County Council has stated that the B.B.C. has been granted the use of a 2-acre site at the Crystal Palace for the erection of a mast and transmitter building to replace the station at Alexandra Palace, the lease for which expires in 1956.

Service Apprentices

PLANS for a National Apprenticeship scheme for service technicians announced by the Radio and Television Retailers' Association at the end of last year have been approved by the Ministry of Labour and the scheme is now in operation.

Controlled by the Joint Standing Committee for the Radio Service Trade (representing the R.T.R.A. and the Guild of Radio Service Engineers) the scheme provides for boys to become apprenticed between the ages of 15 and 16 until they are 21. The employer must allow the apprentice to attend an approved course at a Technical College for one whole day or two separate half days each week, with the proviso that the apprentice should regularly attend evening classes. Although sponsored by the R.T.R.A. the scheme is not exclusively for members of the association.

Apprenticeship terms including recruitment, ratio of apprentices to skilled workers, registration, rates of pay and training are obtainable from the Joint Standing Committee, 26, Fitzroy Square, London, W.1 (Tel. Euston 2662).

Electronics Apprenticeships

IN spite of the fact that the announcement was made only eleven days before the closing date for applications (too late incidentally for inclusion in *W.W.*), some 400 boys between the ages of 16 and 17 applied for the 25 five-year apprenticeships in electronics recently offered by the Ministry of Supply.

The first twelve months of the course will be spent on engineering craft work at one of the Ministry's research establishments or ordnance factories, which will be followed by four years at the School of Electronics, Malvern.

The course is designed to enable apprentices to obtain, at least, the Ordinary National Certificate in Mechanical and Electrical Engineering and the Higher N.C. in Electrical Engineering, with emphasis on electronics.

PERSONALITIES

Sir Noel Ashbridge, who recently retired from the directorship of technical services in the B.B.C., has joined the board of directors of Marconi's W.T. Co., Marconi Marine, Marconi Instruments and English Electric Valve Co. By this appointment he rejoins the organization in which he began his

association with broadcasting, for he was in charge of Marconi's experimental broadcasting station at Writtle for several years prior to joining the B.B.C. in 1926.

Sir Ian Jacob, whose appointment as Director General of the B.B.C. in succession to Sir William Haley (now Editor of *The Times*) was announced on October 8th, has been associated with overseas broadcasting throughout his six years' service with the B.B.C. He joined the Corporation as Controller of the European Service and subsequently became Director of External Broadcasting. He headed the B.B.C. delegation to the Torquay conference in 1950 at which the European Broadcasting Union was formed and was elected its first president.

B. J. O'Kane, Ph.D., B.Eng., A.M.I.E.E., has joined Marconi's as chief air radio engineer. Since 1947 he has been chief engineer of International Aeradio, Ltd., prior to which he was in the G.E.C. Research Laboratories from 1935—with the exception of the war years when he was seconded to T.R.E., Malvern. It will be recalled that he was among the recipients of awards earlier this year for "contributions to the development of radar installations." His claim (with E. J. Dickie) was for the "north-seeking P.P.I." Dr. O'Kane graduated as Bachelor of Engineering (first-class honours) at Liverpool University, where he also obtained his Ph.D.

M. I. Forsyth-Grant, who joined International Aeradio, Ltd., in 1947, has been appointed chief engineer in succession to Dr. O'Kane, to whom he was assistant. Prior to joining I.A.L. he was a research engineer with E.M.I. Engineering Development, Ltd., which he joined in 1939.

H. S. Payman, B.Sc., M.I.E.E., is shortly relinquishing his position as general manager of A. B. Metal Products to take up his appointment as joint managing director of Hawk, Ltd., electrical engineers, of Treforest, Pontypridd, Glam. He was formerly Deputy Director of Communication Components Production, M.A.P.

H. A. Springer, A.M.I.E.E., has been appointed contracts manager of Sangamo Weston, Ltd., which he joined in 1932.

OUR AUTHORS

F. H. Brittain, who contributes the article on p. 440, received his technical training at Faraday House prior to joining the Research Laboratories of the General Electric Co. at Wembley. He at first worked on photoelectric cells and talking films and then joined the newly formed acoustics section in 1929 remaining there for 10 years. During that time he introduced "White Noise" as a reference sound for subjective loudness determinations, and used an analysis of "White Noise" for measuring loudspeaker performance in reverberant surroundings. During the war Mr. Brittain was engaged in the production of silicon of high purity for radar frequency-changers. In 1947 he restarted the acoustics section.

R. W. Leslie, joint author of the article "Automatic Broadcasting" in this issue, joined the B.B.C. at Aberdeen in 1930 and subsequently transferred to the television outside broadcasts section, where he stayed until the outbreak of the war. He then joined the staff of the Superintendent Engineer (Transmitters). In 1944 he went to Italy with the War Reporting Unit. He left the B.B.C. in 1946 to become technical superintendent with the United Insulator Co. at Tolworth, and two years later returned to the Corporation, where he is now in the Planning and Installation Department and is mainly concerned with television transmitters.

C. Gunn-Russell, joint author of the article "Automatic Broadcasting," joined the B.B.C. in 1944 direct from college. After two years in the Lines Department he transferred to the newly formed Designs Department, where he has been mainly concerned with the development of automatic monitoring equipment.

G. Bramsley, contributor of the article on loop aerial reception in this issue, graduated from the Royal Technical College, Copenhagen, Denmark, as radio engineer in 1928. Two years later he joined the Danish Posts and Telegraphs, Radio Department, where he has supervised the erection of transmitting and receiving stations, and from 1939-1946 was engineer-in-charge of the Skamleback transmitting station. Since 1947 he has been working in the broadcasting field planning medium-wave and f.m. stations and investigating aerial design problems.

IN BRIEF

Receiving Licences.—At the end of August there were ten times as many television licences as car-radio licences in the U.K.; 1,597,947, compared with 158,030. The month's increase in television licences was 33,693. The total number of receiving licences was 12,806,012.

British television techniques were recently studied by 17 representatives of broadcasting organizations in Austria, France, Germany, Italy and Sweden during the two-week course arranged by the British Council. The first week of the course was devoted to the television organization of the B.B.C. and the second to visits to manufacturers and the G.P.O. Research Station.

SIR IAN JACOB
(See "Personalities")

Magnetic Recording.—It is announced by the European Broadcasting Union that a technical conference on magnetic recording will be held in Hamburg from November 18th to 22nd, to which representatives of the broadcasting organizations of Europe have been invited.

Television in the Cinema.—The British Kinematograph Society is arranging a series of lectures designed to instruct projectionists and technicians in the principles of television and especially large-screen projection. The first of these will be held at 11 on November 18th at the Birmingham and Midland Institute, Paradise Street (Ratcliff Place entrance). The course is not exclusively for members of the Society, and the fee for non-members is 25/-. Details of this and subsequent lectures in Leeds and Liverpool are obtainable from the Secretary, B.K.S., 164, Shaftesbury Avenue, London, W.C.2.

City and Guilds examination results for 1951 (recently issued by the Department of Technology) record that 70.9 per cent of the 334 candidates for the examination in Radio Service Work passed. 196 of the 298 taking the Radio Servicing Certificate exam., 46 of the 78 taking the Television Servicing Certificate exam. and 505 of the 604 who sat for the Radio Amateurs' exam. were successful. Of the 3,287 taking the radio section of the Telecommunications Engineering course, 1,256 failed, as did 1,578 of the 2,744 who took the exam. in mathematics for telecommunications. The number of candidates for the five sections of the telecommunications (principles) exam. was 8,786, of whom 3,985 failed to reach the requisite standard.

Strasbourg's new medium-wave broadcasting station which came into operation on October 19th has been equipped with three 100-kW transmitters by the French Thomson-Houston Company and a fourth transmitter is to be installed in the near future. Two of the three high-power sets can be coupled together.

Auditoria Acoustics.—A course of three lectures on "The Acoustic Design of Auditoria" will be given by W. A. Allen, B.Arch., A.R.I.B.A., and P. H. Parkin (D.S.I.R. Building Research Station) at the Royal Institution, 21 Albemarle Street, London, W.1, on November 25th, December 2nd and 9th, at 5.15. The fee for the course is 6s.

A.B. Metal Products have been granted the sole manufacturing and distribution rights for the British Empire of the range of resistors and potentiometers manufactured by the Clarostat Manfacturing Co. of New Hampshire, U.S.A. An exchange of engineers has been arranged to facilitate the production of Clarostat components in this country.

Decca's mobile radar demonstration unit started a European tour through Germany, Denmark, Sweden and Norway on September 22nd. It will conclude at Oslo in November. The vehicle, which is completely self-contained, is equipped with both ship-borne and harbour radar.

I.I.E. Award.—John Heywood, who is a technical assistant in the Development Laboratory of Central Rediffusion, Wandsworth, has been awarded a Durham Bursary, valued at £20, by the Junior Institution of Engineers for his thesis "Fading due to Marine Vessel's Aerial System and a Method of Eliminating its Effect."

E.I.B.A. Ball.—The annual ball in aid of the Electrical Industries Benevolent Association will be held on November 14th at Grosvenor House, Park Lane, London, W.1. Tickets, price two and a half guineas, are obtainable from the Association, 32, Old Burlington Street, London, W.1.

Consistent Reception of both the sound and vision signals from Holme Moss at distances varying from 250 to 400 miles during a 30-day field-strength survey in the Atlantic is reported from the motor yacht *Electra* to Pye whose standard FV1 receiver was used. It was found that an inverted "V" or half rhombic aerial with each leg three wavelengths long gave much better reception than the conventional three or four element dipole array.

Commercial Tape Recordings.—Full-length symphonic works are included in the initial list of tape recordings to be issued in America by Mavotape, Inc., and distributed by Magnecord International Ltd., 89, Broad Street, New York 4, N.Y. Recorded on half-tracks of standard-width tape at 7½in/sec, these recordings are claimed to have a frequency range of 50-15,000 c/s with suitable equalization, and to give a playing time of 1 hour from a 7in reel. Price will be according to length, with the 7in reel of 1,200ft (2,400ft of recording) costing 9.95 dollars.

Properties of Metals.—The main section of the "Metal Industry Handbook, 1952," is devoted to the general properties of metals and alloys, while other sections are devoted to general data, electro-plating, a directory of associations and manufacturers, and a buyers' guide. This 41st edition of the Handbook is published in conjunction with the journal *Metal Industry* at a combined subscription of £2 12s.

Multicore have issued a number of new products including a 1lb 50/50-alloy 18-s.w.g. pack. Incidentally, the price of this is inadvertently given as 17/- in the back cover advertisement of this issue; it should be 15/-. Ersin and Arax liquid fluxes are now available in 10oz tins and Multicore solder is now supplied to order in ¼lb reels in even gauges between 24 and 34 s.w.g.; up to now 22 s.w.g. was the finest.

Experimental v.h.f. ship-to-shore radio-telephone service was recently inaugurated in Jersey and Guernsey. The Pye equipment was installed by Rees Mace Marine, Ltd., whose yacht *Pye Dolphin* was used for the inaugural ceremonial cruise over a radius of 20 miles.

Enthoven Solders, Ltd., is the name of the new company formed by H. J. Enthoven & Sons to market the company's solder and solder specialities. The subsidiary company will operate from the head office of the parent company, 89, Upper Thames Street, London, E.C.4 (Tel.: Mansion House 4533).

A British Offshoot of the West German radio company, Grundig Radio-Werke GmbH, has been formed with a factory at Kidbrooke Park Road, London, S.E.3 (Tel.: Lee Green 0768). Chairman and managing director of Grundig (Great Britain), Ltd., is A. E. Johnson, until recently managing director of J. B. Manufacturing (Cabinets), Ltd. George S. Taylor, late of Whiteley Electrical, is sales director, and John M. Ridley, who for the past three years has been editor of *British Radio and Television*, is publicity manager. The company's first product in this country is to be a tape recorder.

G.E.C. has been awarded a ten-year contract to provide and maintain the battery-operated receivers installed by the Community Broadcasting Service of the Malayan Government. Some 720 installations are provided for.

Television Society.—To mark the silver jubilee of the Television Society a booklet has been prepared tracing its history and aims and present activities.

DR. B. J. O'KANE

Marconi's have reorganized their Aeronautical Division, which was formed after the first World War and has been under the management of L. A. Sweny since 1936. Dr. B. J. O'Kane, as reported in "Personalities," has been appointed chief air radio engineer, R. R. Stanford-Tuck as sales manager of the Division, and F. Wheeler, who has been with the company since 1918, as contracts manager.

NEW ADDRESSES

Business Radio.—Marconi's have opened a new depot at 82-86, Belsize Lane, Hampstead, London, N.W.3 (Tel.: Hampstead 4114), for the installation and repair of v.h.f. mobile radio-telephone equipment. Also a sales unit has been established at Marconi House, Strand, London, W.C.2 (Tel.: Temple Bar 1577, ex. 104).

W. Edwards & Co., manufacturers of high-vacuum equipment, of Lower Sydenham, London, S.E.26, have opened a sales and service department at 44, West George Street, Glasgow.

British Communications Corporation has moved its offices and works from Gordon Avenue, Stanmore, to Second Way, Exhibition Grounds, Wembley, Middx. (Tel.: Wembley 1212).

C.R.T. Depots.—Additional depots for testing Ediswan-Mazda cathode-ray tubes have been opened at 53, Trafalgar Street, Sheffield, 1 (Tel.: Sheffield 27004); 53, High Street, Keynsham, Bristol; and 157a, St. Vincent Street, Glasgow, C.2 (Tel.: Central 0687-9).

Metrovick and Ediswan have opened new premises at 10-12, Hospital Street, Birmingham.

Marconi International Marine Communication Co. has opened a new depot at Marconi House, Regent Road, Aberdeen.

MEETINGS

Institution of Electrical Engineers

Radio Section.—"Radio Telemetering" by E. D. Whitehead, M.B.E., B.Sc., and J. Walsh, B.Sc., on November 12th.

"Harmonic Response Testing Apparatus for Linear Systems" by D. O. Burns, B.Sc. (Eng.), and C. W. Cooper, B.Sc. (Eng.), and "A Simple Connection between Closed-loop Transient Response and Open-loop Frequency Response" by J. C. West, B.Sc., and J. Potts, B.Sc., on November 18th. (Joint meeting with Measurements Section.)

"Recent Progress in Radar Duplexers, with special reference to Gas-Discharge Tubes," by P. O. Hawkins on November 24th.

The above meetings will be held at 5.30 at Savoy Place, London, W.C.2.

East Midland Centre.—"The Problems Associated with the Application of Electronics in Heavy Industry" discussion opened by H. E. Knight at 6.30 on November 18th at the Electricity Service Centre, Derby.

Cambridge Radio Group.—Address by E. C. S. Megaw, M.B.E., D.Sc. (chairman of the Radio Section) at 8.15 on November 11th at the Cavendish Laboratory.

North-Eastern Radio Group.—"The General Principles of Digital Computors and their Applications" by Professor F. C. Williams, O.B.E., D.Sc., D.Phil., F.R.S., at 6.15 on November 3rd at King's College, Newcastle-on-Tyne.

"Microwave Radio Links" by A. H. Starr, M.A., Ph.D. and T. H. Walker, B.Sc. (Tech.), at 6.15 on November 17th at King's College, Newcastle-on-Tyne.

North-Western Radio Group.—"Radio Telemetering" by E. D. Whitehead, M.B.E., B.Sc., and J. Walsh, B.Sc., at 6.30 on November 26th at the Engineers' Club, Albert Square, Manchester.

South Midland Radio Group.—"The Teaching of Television Servicing" by R. G. Moseley at 7.0 on November 7th at the Electrical Engineering Dept., College of Technology, Birmingham.

"Radio Astronomy" by K. D. Machin, M.A., at 6.0 on November 24th at the James Watt Memorial Institute, Great Charles Street, Birmingham.

Northern Ireland Centre.—"Some Recent Developments in Phototelegraphy and Facsimile Transmission" by J. Bell, M.Sc., J. A. B. Davidson, M.A., and E. T. A. Phillips at 6.45 on November 11th at Presbyterian Hostel, Howard Street, Belfast.

North Staffordshire Sub-Centre.—"Electronic Telephone Exchanges" by T. H. Flowers, M.B.E., B.Sc. (Eng.), at 7.0 on November 14th at the Post Office Central Training School, Stone.

Southern Centre.—"Radio Controlled Models" by P. A. Cummins at 7.30 on November 12th at the R.A.E. College, Farnborough.

British Institution of Radio Engineers

London Section.—"The Specification and Design of Standardized Units for Electronic Computors" by A. D. Booth, D.Sc., Ph.D., at 6.30 on November 5th at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1.

Scottish Section.—"The Development of the Radio and Electronics Industry in India" by G. D. Clifford, at 7 on November 6th at The Engineering Centre, Sauchiehall Street, Glasgow.

North-Eastern Section.—"Radio Counter Measures" by H. J. Barton-Chapple, B.Sc., at 6 on November 12th at the Institution of Mining and Mechanical Engineers, Neville Hall, Westgate Road, Newcastle-upon-Tyne.

British Sound Recording Association

London.—Discussion on "Problems of Sound Recording and Reproduction" followed by "Brains Trust" at 7 on

November 21st at the Royal Society of Arts, Adelphi, London, W.C.2.

Manchester Centre.—"Some Aspects of Sound-on-Film Recording and Reproduction" by K. Ross at 7.30 on November 24th at the Engineers' Club, Albert Square, Manchester.

Television Society

London.—"Component Reliability in Television Receivers" by Dr. G. David Reynolds, M.Sc., (Murphy Radio), at 7 on November 13th.

"High-Quality Front-Projection Television Receivers" by P. D. Saw (Aren Radio and Television) at 7 on November 28th.

Both the above meetings will be held at the Cinematograph Exhibitors' Association, 164 Shaftesbury Avenue, W.C.2.

Bedford Centre.—"The Paris-London Televis on Link" by T. H. Bridgewater (Supt. Engr. B.B.C.) on November 12th.

"Video-Frequency Amplifiers" by S. W. Amos (B.B.C.) on November 26th.

Both meetings of the Bedford Centre will be held at 8 at the Clapham Road Schools, Bedford.

British Kinematograph Society

Television Division.—"The B.B.C. Television Newsreel" by P. H. Dorte, O.B.E., at 7.15 on November 26th at the Hammer Theatre, Hammer House, Wardour Street, London, W.1.

Institute of Physics

Scottish Branch.—"Meteorological Factors affecting the Propagation of Radio Waves" by J. R. Atkinson at 7 on November 11th in the Natural Philosophy Department, University of Glasgow; at 7 on November 12th in the Natural Philosophy Department, University of Edinburgh, and at 5 on November 13th at University College, Dundee.

"Television" by A. T. Shepherd (Ferranti) at 7 on November 25th in the Natural Philosophy Department, University of Glasgow.

Electronics Group.—"Information Theory" by Dr. P. M. Woodward (T.R.E.) at 5.30 on November 11th at 47 Belgrave Square, London, S.W.1.

Education Group.—"The Teaching of Acoustics" by Dr. R. W. B. Stephens, Dr. E. G. Richardson and E. Nightingale at 5.30 on November 19th, at 47 Belgrave Square, London, S.W.1. (Joint meeting with the Acoustics Group of the Physical Society.)

South Wales Branch.—"Physics and General Science in Schools" discussion at 3 on November 8th at the Technical College, Cathays Park, Cardiff.

Physical Society

Acoustics Group.—"The Normal Threshold of Hearing and other Aspects of Audiometry" by R. S. Dadson (N.P.L.) and "A Summary of the Determination of the Normal Threshold of Hearing" by L. J. Wheeler (Acoustics Laboratory, Central Medical Establishment, R.A.F.) at 5.30 on November 4th at the Imperial College, Exhibition Road, South Kensington.

Institute of Practical Radio Engineers

East Midlands Section.—"Servicing Ekco Television Receivers" by R. Shepherd (Ekco) at 7.30 on November 21st at the Electricity Showrooms, Smithy Row, Nottingham.

Institution of Electronics

North-Western Branch.—"Discharge Mechanisms in Cold-Cathode Valves" by R. W. Murray, M.A., (Ferrant.), at 7 on November 28th in the Reynolds Hall, College of Technology, Manchester.

Radio Society of Great Britain

"The Sky-beam Propagation Problem" by Paul H. Sollom, B.Sc. (G3BGL), at 6.30 on November 21st at the I.E.E., Savoy Place, London, W.C.2.

Unattended Transmitters

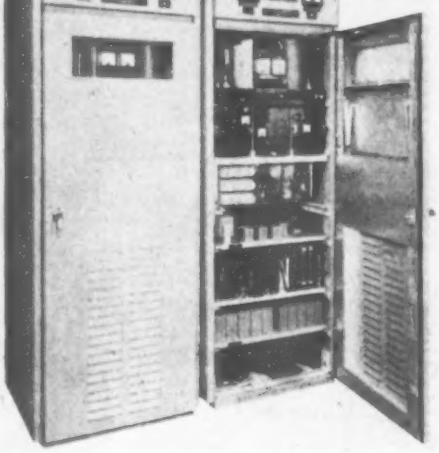
A RECENT trend in broadcasting technique is to cover certain areas by a number of separate low- or medium-power transmitters, all radiating a common programme and controlled from a central point. To this end the unattended transmitter has been designed, with reliability in operation as the foremost consideration. In the range of unattended transmitters made by Marconi this reliability is obtained by paralleling the outputs of a number of small units, each giving 660 watts, so that three will give 2 kW, a convenient power. The circuitry is arranged in such a manner that should any one (or two) of the transmitter units fail it isolates itself and the remainder continue to radiate, so that programme interruption is most unlikely.

The three-unit transmitter, type BD210C, is fitted with two drive units, one operational and one standby, the latter being brought into circuit automatically should a breakdown occur in the working unit. If the transmitter forms one of a group of transmitters working on a common frequency, a synchronized drive unit must be used so that all transmitters in the group are frequency-controlled by the same source.

The transmitter units are themselves constructed on the unit principle, so it is a simple matter to withdraw a faulty unit and replace it by an identical one. Another thing which makes for reliability is the simplicity of design. Apart from the drive equipment only two valve types are used throughout. Moreover, all moving machinery is eliminated, the cooling being done by natural air ventilation. Selenium rectifiers are used for the h.t. supplies, and overload protection relays are incorporated in the final stages. An automatic monitor with each transmitter unit checks the programme quality, phase drift, r.f. amplitude changes and audio distortion, and operates the trip circuits in a faulty unit, so shutting it down.

A simple d.c. system of control is used for transmitter power switching only. This switching is carried out in the transmitter units by a twin-relay system arranged to close the filament and h.t. contactors at the appropriate times. The operation of a single switch, either remotely or locally, will start the transmitter.

Should a fault occur on any transmitter unit, its supply circuits are automatically tripped. To prevent this occurring as a result of a transient surge or non-recurring fault, a three-trip system is used; the h.t. supplies being applied and broken three times, each with an interval of two seconds, before the fault relay takes control and shuts down the whole unit.



Marconi unattended transmitter with door open to show interior.

The circuit design is quite conventional and each transmitter unit comprises, apart from the drive and monitor units, a sub-modulator and cathode follower, modulator and modulated amplifier, and a r.f. amplifier. The output circuit is designed so that the same impedance is always presented across the transmitter terminals regardless of the number of units feeding into the load; thus the modulated amplifier and modulator always work into a constant impedance.

Societies and Clubs

Directory of Radio Groups in the British Isles

ARRANGED alphabetically under towns, the name of the club (and in some cases the club call sign) is followed by that of the secretary, from whom details of the society's activities may be obtained. Clubs which are affiliated to the Radio Society of Great Britain are marked with an asterisk.

ABERDEEN.—Aberdeen Amateur Radio Society*.—G. M. Jamieson, 66, Elmfield Avenue, Aberdeen.

AMERSHAM.—Amersham, Beaconsfield and Chalfonts District Radio Society.—P. L. Spencer, Little Croft, Green Lane, Chesham Bois, Bucks.

BALDOCK.—Baldock Radio Society*.—A. W. Fussell, 6, Clare Crescent, Baldock, Herts.

BARROW - IN - FURNESS.—Barrow Amateur Radio and Television Society*.—J. G. Jackson, 1, Highfield Road, Barrow-in-Furness, Lancs.

BARRY.—St. Athan Amateur Radio Society*.—Sgt. H. Nutty, Sergeants' Mess, 32 M.U., R.A.F., St. Athan, Barry, Glam.

BATH.—Admiralty Electronics Society* (G3BPU).—W. J. Green, "Arrochar," 82, Bloomfield Avenue, Bath, Somerset.

BELFAST.—City of Belfast Y.M.C.A. Radio Club*.—J. Campbell, 16, Lisburn Avenue, Belfast, N. Ireland.

Co-op Radio Society*.—W. F. Jordan, Husband Memorial Hall, Frederick Street, Belfast, N. Ireland.

BIRMINGHAM.—Austin Radio and Television Society*.—R. D. Dixon, Longbridge Works, Birmingham, Warwicks.

Kynoch Radio and Television Society*.—G. E. Nicholls, Time and Work Study Department, I.C.I., Ltd., Elliott Works, Selly Oak, Birmingham, 29, Warwicks.

Midland Amateur Radio Society*.—G. W. C. Smith, 84, Woodlands Road, Birmingham, 11, Warwicks.

Slade Radio Society*.—C. N. Smart, 110, Woolmore Road, Erdington, Birmingham, 23, Warwicks.

University of Birmingham Radio Society (G3IUB).—J. P. G. Jones, The Union, University Road, Edgbaston, Birmingham, Warwicks.

BLACKPOOL.—Blackpool and Fylde Amateur Radio Society*.—H. G. Newland, 161, Penrose Avenue, Blackpool, Lancs.

BOURNEMOUTH.—Bournemouth Radio and Television Society*.—Major W. H. Inchbold Stevens, 47, New Road, Northbourne, Bournemouth, Hants.

BRADFORD.—Bradford Amateur Radio Society*.—A. W. Walmsley, 6, Hilton Road, Legrams Lane, Bradford, Yorks.

BRENTWOOD.—Brentwood and District Amateur Radio Society*.—C. A. Nightingale, 39, Westwood Avenue, Brentwood, Essex.

BRIGHTON.—Brighton and District Radio Club (G3EVE).—R. T. Parsons, 14, Carlyle Avenue, Brighton, Sussex.

East Brighton Short Wave Club*.—F. J. Walton, 104, Warren Way, Woodingdean, Brighton, Sussex.

BRISTOL.—Bristol and District Amateur Radio Society (G3GIS).—N. G. Foord, 71, Brynland Avenue, Bristol, 7, Glos.

CAMBRIDGE.—Cambridge and District Amateur Radio Club*.—T. A. T. Davies, Meadowside, Comberton, Cambridge.

Cambridge University Wireless Society*.—M. Barlow, St. John's College, Cambridge.

Pye Short Wave Radio Society*.—T. Simpson, Radio Works, St. Andrews Road, Cambridge.

CATTERICK.—Catterick Amateur Radio Club*.—J. Phelps, 2 Squadron, 1st Trg. Regiment, Royal Signals, Catterick Camp, Yorks.

CHELTENHAM.—Cheltenham Amateur Radio Society*.—W. Humphries, 8b, Elmfield Avenue, Cheltenham, Glos.

CHESTER.—Chester and District Amateur Radio Society*.—W. G. Lloyd, 124, Tarvin Road, Chester.

CHIPPENHAM. — Colerne Amateur Radio Transmitting Club*.—Sgt. A. G. Parsons, Air Traffic Control, R.A.F., Colerne, Chippenham, Wilts.

CHRISTCHURCH.—S.R.D.E. Amateur Radio Society*.—Capt. J. Singleton, S.R.D.E., Christchurch, Hants.

CLECKHEATON.—Spen Valley Radio and Television Society*.—N. Pride, 100, Raikes Lane, Birstall, Nr. Leeds, Yorks.

CLITHEROE. — Ribblesdale Amateur Radio Society* (G3HYE).—E. Pearson, Back York Street, Clitheroe, Lancs.

COVENTRY.—B.T.H. Social and Athletic Club (Radio and Television Section)*.—The Secretary, Lower Ford Street, Coventry, Warwicks.

Courtaulds Amateur Radio Group*.—P. Stevens, Courtaulds, Ltd., Foleshill, Coventry, Warwicks.

Coventry Amateur Radio Society* (G2ASF).—K. G. Lines, 142, Shorncliffe Road, Coventry, Warwicks.

DARLINGTON.—Darlington and District Amateur Radio Society*.—D. Graham, 21, Hamsterly Street, Darlington, Co. Durham.

DARTMOUTH. — Britannia Radio Club*.—The Secretary, The Royal Naval College, Dartmouth, Devon.

DERBY.—Derby and District Amateur Radio Society*.—E. Shimmin, 74, Derby Lane, Derby.

DEREHAM.—Swanton Morley Amateur Radio Club*.—Flt. Lt. A. E. White, R.A.F., Swanton Morley, Dereham, Norfolk.

DORKING.—Dorking and District Radio Society* (G3CZU).—J. Greenwell, 7, Sondes Place Drive, Dorking, Surrey.

DOUGLAS. — Isle of Man Amateur Radio Society*.—H. Grist, Broadway, Douglas, Isle of Man.

DUNFERMLINE.—Dunfermline Radio Society*.—D. R. Leah, 9, Bentfield, Burntisland, Fife.

EAST GRINSTEAD.—East Grinstead and District Amateur Radio Club.—F. J. Glynn, The Mount, 13, Station Road, East Grinstead, Sussex.

ECCLES. — Eccles and District Radio Society*.—E. Rayson, 11, Hartington Road, Winton, Eccles, Lancs.

EDINBURGH. — Edinburgh Amateur Radio Club*.—C. L. Patrick, 19, Montgomery Street, Edinburgh.

EXETER.—Exeter Radio and Television Club.—L. R. Jenkin, 16, South Avenue, Exeter, Devon.

FAKENHAM.—West Raynham Amateur Radio Society*.—Sgt. Aveling, R.A.F. Station, West Raynham, Fakenham, Norfolk.

FORFAR.—Forfar and District Amateur Radio Club*.—J. Patterson, 19, Taranty Road, Forfar, Angus.

GATESHEAD.—Gateshead and District Amateur Radio Club*.—J. Kennedy, 11, Lanthwaite Road, Low Fell, Gateshead, 9, Co. Durham.

GERRARDS CROSS.—British Amateur Television Club*.—M. Barlow, Cheyne Cottage, Dukes Wood Drive, Gerrards Cross, Bucks.

GILLINGHAM.—Medway Amateur Receiving and Transmitting Society*.—C. R. Hawkins, 9, Sanctuary Road, Gillingham, Kent.

GLASGOW.—Western Short Wave Club (GM3HYI).—R. F. D. Moir, 18, Haldane Street, Glasgow, W.4, Lanarks.

HARLOW.—Harlow and District Radio Society*.—H. I. Wright, Allandale Start Hill, Bishop's Stortford, Herts.

HENLOW.—R.E.U. Amateur Transmitting Society*.—Sqn. Ldr. Copeland, 128a, Officers' Married Quarters, R.A.F., Henlow, Beds.

Shefford and District Radio Society*.—D. J. Roper, 294F, Married Quarters, R.A.F., Henlow, Beds.

HERTFORD. — Hertford and District Radio Society*.—R. L. S. Harrison, 12, Westfield Road, Bengeo, Herts.

IXWORTH. — Ixworth Radio Club (G3HWP).—P. G. Wright, Thurston Road, Gt. Barton, Nr. Bury St. Edmunds, Suffolk.

KENILWORTH.—Kenilworth Radio and Television Society*.—S. Smith, 40, Stoneleigh Road, Kenilworth, Warwicks.

LEEDS. — Leeds Amateur Radio Society*.—W. Hawkridge, 7, Langdale Gardens, Leeds, 6, Yorks.

LEICESTER.—Leicester Radio Society*.—A. L. Milnthorpe, 3, Winster Drive, Thurmaston, Nr. Leicester.

LEIGHTON BUZZARD. — R.A.F. Bletchley Amateur Radio Society*.—F/O. R. Curtis, 6, Officers' Mess, M.Q., R.A.F., Stanbridge Road, Nr. Leighton Buzzard, Beds.

LEWES.—Lewes and District Model Engineering Club (Radio Section)*.—P. A. Murphy, 22, Malling Down, Lewes, Sussex.

LINCOLN.—Linco'n Short Wave Club*.—G. C. Newby, 18, Birchill, Fiskerton, Lincoln.

LIVERPOOL. — Merseyside Radio Society*.—A. Bell, 20, Craigside Avenue, West Derby, Liverpool, 12, Lancs.

Merseyside Wireless Transmitting Amateur Society*.—S. Orr, 2, Argyle Road, Anfield, Liverpool, 4, Lancs.

West Lancashire Radio Society*.—B. J. Whitty, 46, Argo Road, Waterloo, Liverpool, 22, Lancs.

LONDON AREA†. — Ariel Radio Group*.—W. J. Hayes, Bush House Section, B.B.C. Club, Bush House, Aldwych, W.C.2.

Babcock and Wilcox Staff Association Radio Society*.—L. E. J. Manders, 207, French Street, Sunbury-on-Thames, Middx.

Barnet and District Radio Club*.—A. D. Cliff, Hopedene, The Avenue, Barnet, Herts.

City and Guilds College Radio Society* (G5YC).—R. Leek, City and Guilds College, Exhibition Road, S. Kensington, S.W.7.

East Surrey Radio Club*.—L. Knight, Radiohme, 6 Madeira Walk, Reigate, Surrey.

Edgware and District Radio Society*.—R. H. Newland, 10, Holmstall Avenue, Edgware, Middx.

Electronics and Amateur Radio Society*.—M. S. Thayer, Queen Mary College, Mile End Road, E.1.

Grafton Radio Society* (G3AFT).—A. W. H. Wennell, 145, Uxendon Hill, Wembley Park, Middx.

Gravesend Amateur Radio Society*.—R. E. Appleton, 23, Laurel Avenue, Gravesend, Kent.

† Based on the G.P.O. London Telecommunications Region.

Grays and District Amateur Radio Society*.—C. Mundy, 68, Chestnut Avenue, Grays, Essex.

Great Portland Radio Club*.—V. F. Turner, 18, Henley Road, Edmonton, N.18.

Harrow Radio Society* (G3EFX).—S. C. Phillips, 131, Belmont Road, Harrow Weald, Middx.

Haddesdon and District Radio Society.—T. Knight, Canton House, High Street, Haddesdon, Herts.

Ilford and District Radio Society*.—C. E. Largen, 44, Trelawny Road, Barkingside, Ilford, Essex.

International Radio-Controlled Models Society.—C. H. Lindsey, 292, Bramhall Lane South, Bramhall, Stockport, Cheshire.

Kingston and District Amateur Radio Society*.—R. S. Babbs, 28, Grove Lane, Kingston-on-Thames, Surrey.

Murphy Radio Sports Club (Radio Section)*.—R. Stevenson, Murphy Radio, Ltd., Broadwater Road, Welwyn Garden City, Herts.

North Kent Radio Society* (G3ENT).—C. J. Leal, 1, Deepdene Road, Welling, Kent.

North-West Kent Amateur Radio Society*.—M. J. Frost, 15, Northbourne, Hayes, Bromley, Kent.

Port of London Authority Staff Club (Radio Section)*.—R. T. Seaton, Lighterage Office, Northern Department, Millwall Dock, E.14.

Purley and District Radio Club*.—A. Frost, 18, Beechwood Avenue, Thornton Heath, Surrey.

QRP Research Group*.—J. Whitehead, The Retreat, Ryden's Avenue, Walton-on-Thames, Surrey.

Queensbridge Radio Club*.—R. H. Lamb, 17, Queens Road, Leytonstone, E.11.

Romford and District Amateur Radio Society*.—D. L. Coppendale, 9, Morden Road, Chadwell Heath, Romford, Essex.

Sanderstead and Purley Amateur Radio Society*.—T. R. Young, 41, Lansdowne Road, Purley, Surrey.

South-West Essex Radio Club*.—L. G. Barret, 167, Rush Green, Romford, Essex.

Surrey Radio Contact Club*.—S. A. Morley, 22, Old Farleigh Road, Selsdon, Surrey.

Sutton and Cheam Radio Society* (G3GFA).—F. J. Harris, 143, Collingwood Road, Sutton, Surrey.

Thames Valley Amateur Radio Transmitters' Society*.—K. A. H. Rogers, 21, Links Road, Epsom, Surrey.

Vickers-Armstrong, Ltd. (Weybridge) Social and Athletic Club (Electronics Section)*.—A. W. Warner, Sales Accounts Department, Vickers-Armstrong, Ltd., Weybridge Works, Weybridge, Surrey.

Wanstead and Woodford Radio Society*.—J. Binning, 150, Upton Park Road, Forest Gate, E.7.

Watford Amateur Radio Society*.—R. W. Bailey, 32, Cassiobury Drive, Watford, Herts.

West Middlesex Radio Club* (G3EDH).—P. W. Smith, 121, Richmond Avenue, Hillingdon, Middx.

Woolwich Radio Society*.—A. J. Burch, 60, Sutcliffe Road, S.E.18.

LOWESTOFT.—Lowestoft and Eccles Amateur Radio Club*.—E. Lock, 34, Nelson Road, Pakefield, Lowestoft, Suffolk.

LUTON.—Luton and District Radio Society*.—E. Radford, 37, Wilsden Avenue, Luton, Beds.

MAIDSTONE.—Mid-Kent Amateur Radio Society*.—D. A. Mullen, 44, Sussex Road, Maidstone, Kent.

MANCHESTER.—Faculty of Technology Amateur Radio Society*.—M. J. Fadil, College of Technology, Sackville Street, Manchester, Lancs.

Manchester and District Radio Society, P. Dean, "Fairfield," 31, Park Lane, Whitefield, Lancs.

South Manchester Radio Club*.—P. Hudson, 21, Ashbourne Road, Stretford, Manchester, Lancs.

MANSFIELD.—Mansfield District Radio Society*.—A. W. Fowler, Windsor, Cowpasture Lane, Sutton-in-Ashfield, Notts.

MIDDLESBROUGH.—Tees-Side Amateur Radio Society (G3HUG).—H. Walker, 64, Ayresome Street, Middlesbrough, Yorks.

NEWBURY.—Newbury and District Amateur Radio Society*.—A. W. Grimsdale, 164, London Road, Newbury, Berks.

NEWCASTLE-ON-TYNE.—North East Amateur Transmitting Society*.—L. Bergna, 121, Addycombe Terrace, Newcastle-on-Tyne, 6, Northumberland.

NORTHAMPTON.—Northampton Short Wave Radio Club* (G3GWB).—V. R. Hartopp, 22, Purser Road, Northampton.

NOTTINGHAM.—Nottingham University Radio Society*.—G. M. Bayley, The Union Room, University, Nottingham.

OXFORD.—Oxford and District Amateur Radio Society*.—J. Hickling, 47, Banbury Road, Oxford.

PENZANCE.—West Cornwall Radio Club*.—R. V. Allbright, 12, North Parade, Penzance, Cornwall.

PORTSMOUTH.—Portsmouth and District Radio Society* (G3DIT).—L. V. Shaw, 8, Belmont Street, Southsea, Hants.

PRESTON.—Preston Radio Society*.—L. Hall, 7, Lilac Grove, Holme Slack, Preston, Lancs.

RAMSGATE.—Isle of Thanet Radio Society*.—J. P. Barnes, 18, Grange Road, Ramsgate, Kent.

READING.—Army Apprentices' School Radio Club (G3HOS).—F. A. Hall, c/o Tels. Dept., A.A.S., Arborfield, Berks.

R.E.M.E. Radio Club*.—Pte. M. Ray, Hazebrouck Barracks, Arborfield, Berks.

Reading Radio Society*.—L. A. Hensford, 30, Boston Avenue, Reading, Berks.

ROTHERHAM.—Rotherham Radio Club*.—W. Darby, 1, New Houses, Fence, Woodhouse Mill, Nr. Sheffield, Yorks.

ROYSTON.—Royston and District Radio Club*.—F. A. M. Ashton, 115, Melbourn Road, Royston, Herts.

RUGBY.—B.T.H. Recreation Club (Radio and Television Section)*.—P. N. Prior, B.T.H. Recreation Club, Rugby, Warwicks.

SALISBURY.—Salisbury and District Short Wave Club* (G3FKF).—V. G. Page, 32, Feversham Road, Salisbury, Wilts.

SHEFFIELD.—Sheffield Amateur Radio Club*.—E. Walker, 20, Dalewood Road, Sheffield 8, Yorks.

SOUTH SHIELDS.—South Shields and District Amateur Radio Club*.—W. Dennell, 12, South Frederick Street, South Shields, Co. Durham.

SOUTHAMPTON.—A.S.T. Amateur Radio Society*.—J. N. Tracey, Air Service Training Mess, Hamble, Southampton.

SOUTHEND.—Southend and District Radio Society* (G5QK).—T. W. Hudson, 27, Park Road, Southend-on-Sea, Essex.

SOUTHPORT.—Southport Radio Society*.—F. H. P. Cawson, 113, Waterloo Road, Southport, Lancs.

STOKE-ON-TRENT.—Stoke-on-Trent Amateur Radio Society.—J. R. Brindley, 45, Rosendale Avenue, Chesterton, Newcastle, Staffs.

STOURBRIDGE.—Stourbridge and District Amateur Radio Society*.—W. A. Higgins, 28, Kingsley Road, Kingswinford, Brierley Hill, Staffs.

STROUD.—Stroud and District Amateur Radio Society*.—B. L. Horton, Prescott, Haven Avenue, Bridgend, Stonehouse, Glos.

TAUNTON.—Taunton and West Somerset Radio Society*.—H. E. J. Burton, 33, Richmond Road, Taunton, Somerset.

TORQUAY.—Torbay Amateur Radio Society*.—W. A. W. Launder, 15, Cambridge Road, St. Marychurch, Torquay, Devon.

TUNBRIDGE WELLS.—West Kent Radio Society*.—L. S. King, Glenisla, Maidstone Road, Pembury, Kent.

WALSALL.—Walsall and District Amateur Radio Society*.—F. J. Merriman, 123, Wolverhampton Road, Walsall, Staffs.

WARRINGTON.—Risley Radio Society*.—D. E. Harper, Risley Club, Risley Road, Nr. Warrington, Lancs.

Warrington and District Radio Society*, S. Wood, 12, Thelwall Lane, Latchford, Warrington, Lancs.

WELLINGBOROUGH.—Wellingborough and District Radio and Television Society.—N. M. Seabrooke, 85, The Drive, Wellingborough, Northants.

WELLINGTON.—Wrekin Amateur Radio Society*.—J. C. Tranter, 78, New Street, Wellington, Salop.

WELLS.—Wells and District Amateur Radio and Television Society.—W. L. Woodcraft, Haversham House, New Street, Wells, Somerset.

WESTON-SUPER-MARE.—R.A.F. Amateur Radio Society*.—The Secretary, No. 1 Radio School, R.A.F. Locking, Weston-Super-Mare, Somerset.

WEYMOUTH.—Weymouth Radio and Television Club*.—R. Figg, 4, Dorset Place, Weymouth, Dorset.

WIRRAL.—Wirral Amateur Radio Society*.—A. H. Watts, 14, Grange Crescent, Hooton, Wirral, Cheshire.

WOLVERHAMPTON.—Wolverhampton Amateur Radio Society*.—H. Porter, 221, Park Lane, Wolverhampton, Staffs.

WORTHING.—Worthing and District Amateur Radio Club*.—R. Chidzey, 33, Bruce Avenue, W. Worthing, Sussex.

YEOVIL.—Yeovil Amateur Radio Club*.—D. McLean, 9, Cedar Grove, Yeovil, Somerset.

YORK.—York Amateur Radio Society* (G3HWW).—G. F. Nottingham, 51, Carr Lane, Acomb, York.

CLUB NEWS

Birmingham.—A lecture-demonstration on "High-Quality Magnetic-Tape and Gramophone Reproduction," which will include some stereophonic recordings, will be given by C. Banks and J. Hickman (C.J.R. Electrical and Electronic Development) to members of the Slade Radio Society on November 7th in the Lecture Theatre, Aston Technical College, Whitehead Road, Aston, Birmingham. Meetings are held on alternate Fridays at 7.45.

Bristol and District Amateur Radio Society, which until last year was known as the Bristol and District Short-Wave Listeners' Club, meets formally each Friday in the St. Mary Redcliffe Church Hall, Guinea Street, Redcliffe, and on Tuesdays for c.w. courses and Wednesdays for constructional work.

East Grinstead and District Amateur Radio Club now meets on alternate Thursday evenings in Portland Hall, Portland Road, East Grinstead.

Northampton.—Meetings of the Northampton Short-Wave Radio Club are held each Friday at 6.30 at Allen's Pram Works, 8, Duke Street, when the club transmitter (G3GWB) operates on two metres.

Reading.—Membership of the club attached to the Army Apprentices' School at Arborfield, Berks, is limited to 30 and since its formation 18 months ago has reached the maximum. Meetings are held each Thursday, when the club transmitter (G3HOS) is on the air in the 80-metre band.

Wellingborough.—Officially launched on September 11th, the Wellingborough and District Radio and Television Society now meets fortnightly at the B.R. Sports and Social Club, Broad Green, Wellingborough.

MARCONI

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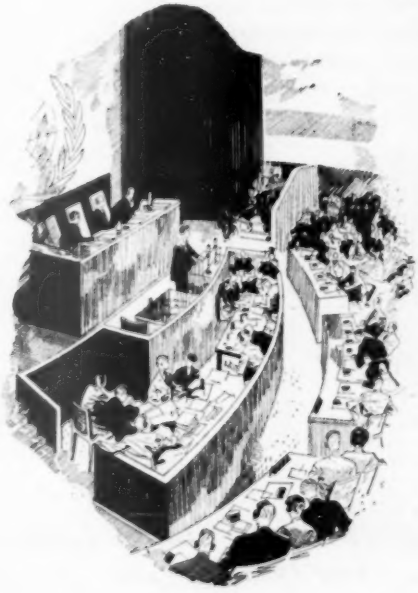
mankind



Marconi was a lone thinker who revolutionised communications by methods "the entire meaning of which no one before him had recognised." There is a great contrast between his crude copper-sheet aerial and the Marconi equipment which televises such programmes as the opening of the new House of Commons and the sessions of the United Nations. But there is also a great similarity—Marconi's tradition of service to mankind.

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At any frequency up to 5 Mc/s . . . at any voltage from 0.5 volt upwards to tens of thousands . . . at current ratings from 1 m/A upwards, there is almost certain to be a **SenTerCel Selenium Rectifier** which will do a better, more reliable job.

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ELECTRONIC SWITCHING

(Concluded from page 423 of previous issue.)

Part 2.—Applications of the Cold-cathode Gas Discharge Triode

By E. A. R. PEDDLE* B.Sc. (Hons.)

ONE application of the cold-cathode triode similar to that of the diode is the simple coincidence gate shown in Fig. 7(a). The tube is only triggered when the anode and trigger pulses coincide, and only remains conducting for the duration of the anode pulse. The modified circuit in Fig. 7(b) uses a fixed anode supply which, in conjunction with the trigger pulse and trigger load, is insufficient to trigger the tube (see Fig. 5 in Part I last month). As before, the tube will only trigger when there is a coincidence of an anode input pulse and a trigger input pulse. Provided, however, that the fixed anode potential is sufficient to maintain the discharge, the tube not only detects this coincidence but also stores the information by its conducting condition.

Owing to the presence of the trigger electrode, cold-cathode triodes have many more applications[4,5,6] than the diodes. The simple cross-bar switch circuit shown in Fig. 8 is an example. Here, the use of triodes enables any one of three inputs to be connected to either of two outputs provided they are not already in use. Operation of switch A applies a triggering potential to tubes 11 and 21. Assume that tube 11 triggers before 21. The rise in cathode potential of 11 prevents 21 from triggering, and the fall in the anode potential of 11 is such that triggering pulses applied through switches B and C cannot trigger tubes 12 and 13. The input A is now connected to the output X through the ionized gas of tube 11. If now switch C is operated, the triggering potential can only trigger tube 23, and the fall in anode potential of 23 prevents tubes 21 and 22 from triggering. The input C is connected to output Y and, if switch B is now operated, neither 12 nor 22 can be triggered. The number of inputs and outputs can be extended, the principle of operation of the circuit depending on the control of triggering shown in Fig. 5.

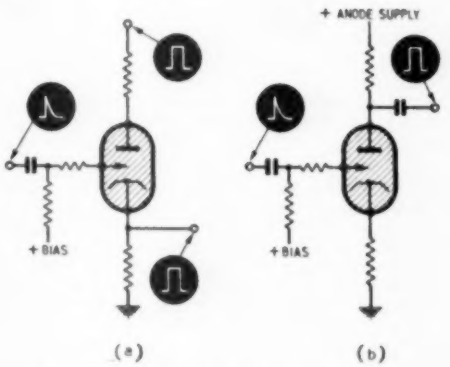


Fig. 7. Gate circuits using cold-cathode triodes, (a) simple coincidence gate, (b) coincidence gate and store.

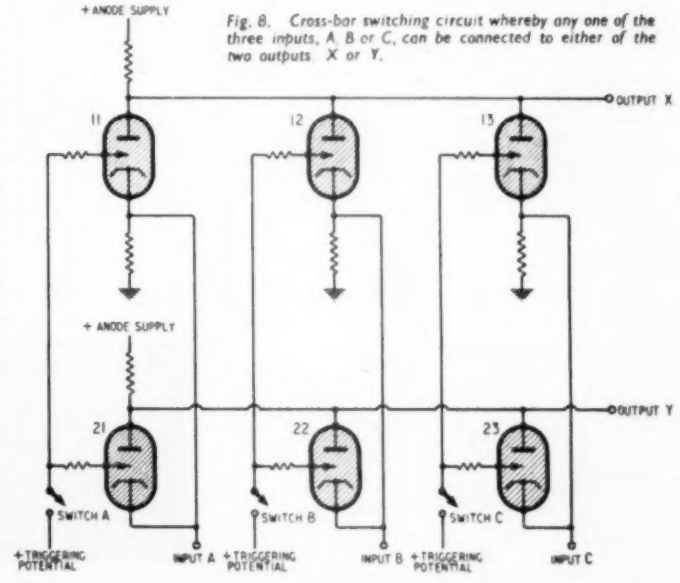


Fig. 8. Cross-bar switching circuit whereby any one of the three inputs, A, B or C, can be connected to either of the two outputs, X or Y.

* Research Laboratories of the General Electric Company.

[4] S. B. Ingram, "Cold Cathode Gas-Filled Tubes as Circuit Elements," *Trans. A.I.E.E.*, **58**, 342 (1939).

[5] W. A. Depp, "Circuits for Cold Cathode Glow Tubes," Bell Tech. Monograph B1685.

[6] O. C. Shumard, "Some Electronic Switching Circuits," *Electrical Engineering*, **57**, 209 (1938).

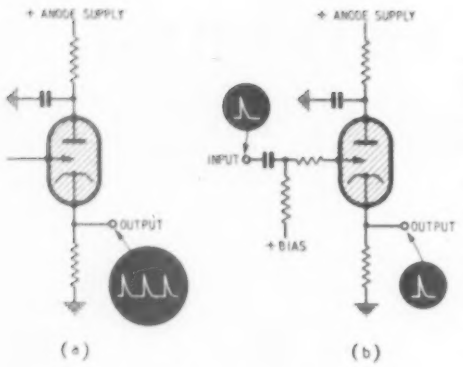


Fig. 9. Relaxation oscillator circuits, (a) straightforward circuit, (b) circuit used for impedance transforming.

In many low-frequency electronic switching applications the cold-cathode triode can be used as a relaxation oscillator for providing a source of frequency. The large difference between anode breakdown potential and extinction potential can be utilized to give output pulses of large amplitude, while the frequency can be stabilized to within 1% by using a high-stability anode supply and a constant source of illumination. A typical oscillator circuit is shown in Fig. 9(a), together with the associated output waveforms. By using the triode as shown in Fig. 9(b), a pulse of small amplitude which comes from a high impedance source can be changed into a pulse of larger amplitude coming from a lower impedance source. The anode supply potential is lower than the breakdown potential, so that the tube is only triggered by pulses applied to the trigger electrode in the normal manner. Each input pulse to the trigger electrode causes the tube to conduct, the anode circuit being such as to extinguish the tube in a manner similar to that of the relaxation oscillator. Thus each positive input pulse to the trigger electrode will produce a positive output pulse on the cathode, the former being presented with the high input impedance of the trigger circuit and the latter coming from the low output impedance of the cathode circuit. The amplitude of the input pulse has only to be sufficient to trigger the tube, whilst the amplitude of the output pulse depends only upon the tube characteristics. In this way the tube forms a very useful buffer stage.

Cold-cathode triodes can also be connected as multivibrators and can be used in three states: (a) monostable, for use as a pulse-widener or delay circuit, (b) bi-stable, for use as a binary element, and (c) free-running, for use as a pulse generator. The most commonly used forms are (a) and (b), illustrated in Fig. 10. In (a) is one form of a pulse-widener. Tube B is normally conducting, the trigger electrode being connected to a potential sufficient to trigger the tube. A positive input pulse triggers tube A and the fall in anode potential is used to extinguish tube B through the anode coupling capacitor C_1. This fall in anode potential, though capacitor C_2, is also used to lower the potential applied to the trigger of tube B below its triggering potential. After an interval determined

Fig. 10. Multivibrator circuits, (a) monostable type, (b) bi-stable type.

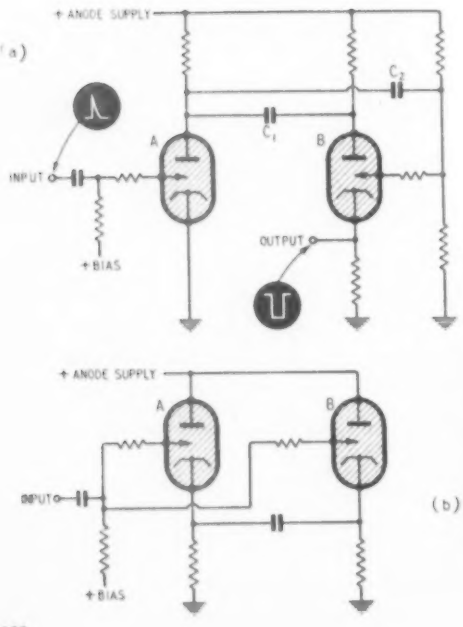
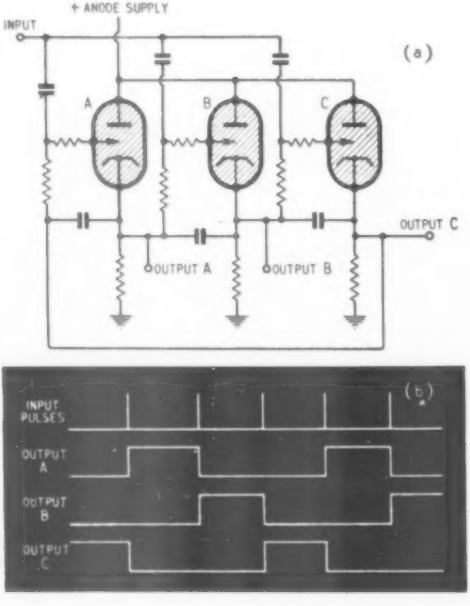


Fig. 11. Digital chain counter circuit (a), with (b) pulses obtained from cathodes of the tubes.



by the time constants of the circuit, the potential applied to the trigger will rise to the triggering value. Tube B will now re-trigger and in doing so will extinguish tube A. The period for which B is non-conducting, and its cathode is at earth potential, is determined by tube and circuit constants. A positive delayed pulse can be obtained by differentiating the output pulse from the cathode of tube B.

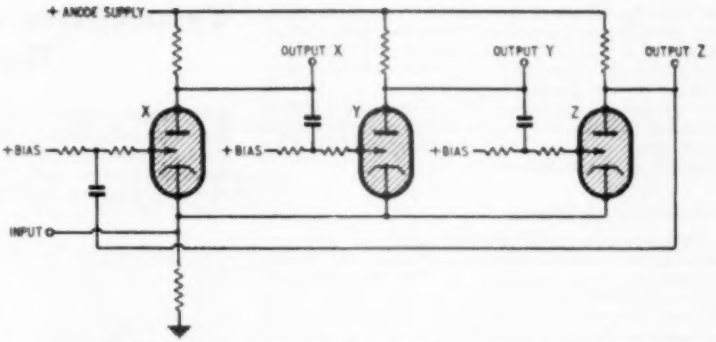


Fig. 12. Another digital chain counter using tubes with a common cathode impedance.

The bi-stable state is illustrated in Fig. 10(b). The trigger electrodes of tubes A and B are connected to a common bias supply and input. Suppose A is conducting, then the first positive input pulse will trigger tube B. The rise in cathode potential of tube B is used to extinguish tube A through the cathode coupling capacitor. The next input pulse triggers the tube A, which extinguishes tube B, and so on. Hence tube B is conducting for every second input pulse, so that the circuit is acting as a single-stage binary counter.

Digital Chain Counters

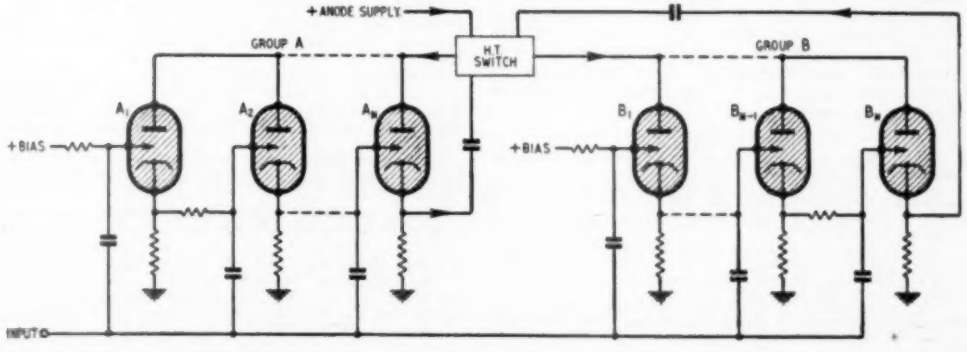
The most useful cold-cathode tube counter in electronic switching is the digital chain counter, which can also be used as a pulse distributor. Digital chain counters can be divided into two classes, depending upon the principle of operation. First, where the input pulse triggers a tube which extinguishes a previously conducting tube or tubes, and second, where the input pulse extinguishes a tube which causes the succeeding tube to trigger. Further subdivision can be made according to the nature of the input pulse and the electrode to which it is applied.

Examples of the two classes of digital chain counters are shown in Figs. 11 and 12. In Fig. 11(a) if tube A is conducting, its cathode potential is applied as positive bias to the trigger of the next tube B. The next positive input pulse will trigger tube B and no other. When tube B conducts, its rise in cathode potential is used to extinguish tube A by means of the cathode coupling capacitor. Fig. 11(b) shows the time-distributed positive pulses which are obtained from the cathodes of the tubes A, B and C.

In Fig. 12 the tubes have a common cathode impedance. The input pulses are positive and are such as to extinguish any tube which is conducting. If X is conducting the next input pulse will extinguish it, and the subsequent rise in anode potential is used to trigger the next tube Y. Negative output pulses can be obtained from the anodes of the three tubes at X, Y and Z.

In these and similar circuits, the speed of counting is limited to about 200c/s by the extinction time of the tubes. It is however possible to increase counting time, and thus extend the operating range, by extinguishing the tubes in groups rather than in sequence. Such an arrangement is shown in Fig. 13, where two groups of tubes, A and B are connected to a switch which applies h.t. to either group. If h.t. is applied to group A, the first input pulse triggers tube A_1 and the nth pulse triggers the nth tube A_n. When A_n triggers, a pulse is taken from its cathode and operates the h.t. switch. This transfers h.t. from the group A tubes, which are extinguished, to the group B tubes, which can now trigger. The process is reversed when

Fig. 13. High-speed digital chain counter circuit with tubes extinguished in two groups, A and B.



B_n triggers. The time taken between the firing of A_n and that of B_n must therefore be less than the extinction time t_b of a single tube. The maximum frequency of operation is thus equal to $N \setminus t_b$, where N is the number of tubes in each group. If t_b is 0.002 sec and N is 10, the maximum frequency of operation is 5,000c/s, provided that the h.t. switch, which may be a high-speed relay or a hard valve multivibrator, can be operated at this frequency.

Poly-electrode Tubes

In the poly-electrode diode, a common anode (or cathode) is associated with a multiplicity of cathodes (or anodes), the ionization in one anode-cathode gap being sufficient to trigger the other gaps. When the tube is non-conducting, the circuits connected to, say, each anode are electrically isolated, but an input signal to one anode can switch on a much greater current than if separate cold-cathode diodes were used.

Special counting tubes, using a common anode and a number of cathodes, have been developed.[7, 8, 9] The discharge occurs between the anode and a single cathode and is made to transfer to the next cathode by the input pulse applied to a number of guide electrodes situated between the cathodes. The principle of transferring the glow, rather than extinguishing and reforming elsewhere as in the chain counters described above, enables much higher counting speeds to be reached. Counting speeds of 20kc/s are possible. Poly-cathode tubes have been made with an external connection to each of the cathodes for use as distributors as well as counters and dividers. Compared with cold-cathode triode chain distributors, the higher anode potentials and drive circuits required may limit their use for very low frequency application on economic grounds.

The wide variety of switching applications described serves to show the versatility of cold-cathode gas discharge devices. Two further characteristics of these tubes should be mentioned. The end of the useful life of a tube is characterized by an increase in both the breakdown and maintaining potentials. In activated tubes, this effect can be related to the removal of the activating substance by sputtering.[10] The maximum operating current is mainly determined by the life required. In practice the tubes are operated at the lowest current possible but with due regard to the variation in the maintaining potential.

Again, most cold-cathode gas discharge devices present a serious problem in applications involving speech transmission, owing to the presence of random oscillations in the audio range which may vary in amplitude from tens of millivolts to several volts. High frequency oscillations of the order of 1Mc/s are also present but are usually less important. The theoretical interpretation of these oscillations is by no means complete, [11, 12] and they still represent a barrier to many uses.

[7] R. C. Bacon and J. R. Pollard, "The Dekatron," *Electronic Engineering*, **22**, 173 (1950).

[8] G. M. Hough, D. S. Ridley, "Multi-Cathode Gas Tube Counters," *Electrical Communication*, **27**, 214 (1950).

[9] J. R. Acton, "The Single-Pulse Dekatron," *Electronic Engineering*, **24**, 48 (1952).

[10] G. H. Rockwood, "Current Rating and Life of Cold Cathode Tubes," *Trans. A.I.E.E.*, **60**, 901 (1941).

[11] D.S.I.R. Radio Research Special Report No. 20, "Valve and Circuit Noise," H.M.S.O., 1951.

[12] E. B. Armstrong, K. G. Emeleus and T. R. Neill, "Low Frequency Disturbances in Gaseous Conductors," *Proc. Roy. Irish Acad.*, **54**, 291 (1951).

Transmitting Marker Buoy

UNDER stress of weather, fishing vessels often have temporarily to abandon their gear, and when hove-to may drift out of sight of flagged dahn buoys put down to mark its position. To save valuable time and steaming distance in picking up gear again after a "blow," Venner Electronics, Kingston By-pass, New Malden, Surrey have produced a wireless transmitting dahn buoy, the signal from which on 151 metres can be "homed" on by the trawler's normal direction-finding equipment.

The Venner wireless transmitting buoy is designed to minimize rolling and weighs only 30.0 lb.

The transmitter, which is battery operated, is of sufficient power to give a reliable range of 30 miles and has a duration of 72 hours on a charge. The batteries are charged via a watertight plug on the exterior of the casing. A delay switch between battery and transmitter can be set to start the transmitter at any period up to 48 hours from the time of laying, according to the skipper's estimate of the probable duration of the "blow." An important feature of the design is the inclusion of automatic keying to send out the trawler's call sign plus a numeral.

In addition to the whip aerial the buoy may be fitted alternatively with a corner reflector, giving an effective range of seven miles on radar equipment, or with a basket which gives visual indication and also serves as a fend-off to protect the aerial when alongside. A flashing masthead light is fitted to both types.

Manufacturers' Literature

Ultrasonic Soldering Iron and Tinning Bath, suitable for soldering aluminium, described in a brochure from Mullard, Ltd., Century House, Shaftesbury Avenue, London, W.C.2.

Rectification; an illustrated booklet giving general instructions on the use of Westinghouse copper-oxide and Westalite rectifiers, from the Westinghouse Brake & Signal Co., Ltd., 82, York Way, King's Cross, London, N.1.

Instrument Cases briefly described in a leaflet from Joyce, Loebl & Co., Ltd., Vine Lane, Newcastle-upon-Tyne, 1.

Resistance Alloys; leaflets giving physical properties, wire data and general notes on Isabellin NCM and Isabellin A (similar to Constantan) and Manganin. From Isabellen-Hütte Heusler K.-G., Dillenburg, Germany.

"Sub-miniature" Soldering Irons for low-voltage working (6 V, 12 V or 24 V); leaflets describing and giving figures for the complete range, from Oryx Electrical Laboratories, BCM/ORYX, London, W.C.1.

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Loop Aerial Reception

Design for Reducing Noise Level on Long Waves

By G. BRAMSLEV*

IT is well known that the r.f. noise generated by electrical machinery and switches is more troublesome on the long-wave band than on medium waves. Consequently, although much is done nowadays to prevent radiation of these disturbances, the potentially great ranges of long-wave broadcasting stations cannot be fully realized in heavily electrified districts. Sometimes there are supplementary medium-wave transmissions of the programme, but many listeners are still forced to rely on the long waves. Those, in particular, who live at great distances from the transmitting station may be interested in this method of reducing the noise level at their receivers by means of a loop aerial.

This well-known type of aerial is used much in portable receivers and for direction finding, but its noise-reducing properties, which have been mentioned by Goldman,† are not so well known, and in this article the loop will be treated as an aerial connected to an ordinary broadcast receiver specifically for this purpose. To understand its noise reducing effect it is necessary to consider the nature of the interference fields and the way in which they act upon the loop. Because these fields have their origin in r.f. voltages and currents in the house wiring or nearby overhead electrical wires, the receiving aerial is so close to the sources that it is the induction field rather than the radiation field which is involved. In a radiation field the electric and magnetic forces are interdependent, but in an induction field the electric and magnetic forces are simple alternating fields associated with the voltage and current in the wires, and can be considered to act to some extent independently.

Let us first consider the action of an alternating magnetic field on a loop aerial. A voltage will be induced in the loop when the magnetic lines of force are cutting the plane of the winding, and when they are parallel to it no voltage will be induced. That is to say, the loop directivity can be used to reduce interference caused by magnetic noise fields provided these make a sufficient angle to the magnetic field of the desired radio wave.

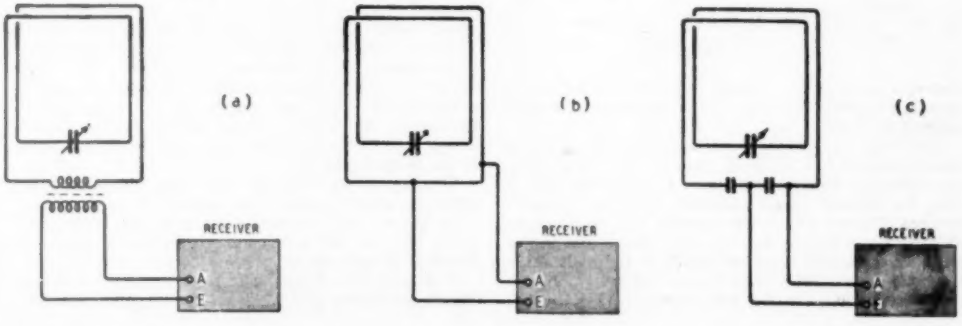
The lines of electric force in the noise field will be more or less vertical, and will accordingly develop a r.f. potential between the loop winding and earth. If the loop winding is balanced to earth, however, as it normally should be, this potential will not give rise to any current in the loop circuit, and so will not produce a noise voltage in the receiver, irrespective of the orientation of the loop.

These receptive properties of a loop are quite different from the response of ordinary capacitive aerials to electric and magnetic fields. Almost always capacitive aerials respond strongly to electric fields, but are less sensitive to magnetic fields. Now it is the general experience that in the noise fields originating from most electric appliances the electric component predominates, particularly in the long-wave band, so a loop aerial should be able to discriminate against the noise better than a capacitive aerial on the same spot. That this is possible has been confirmed by numerous experiments, and in many cases when a comparison is made with a rather small indoor aerial the signal-to-noise ratio improvement can be of a very high order. The following figures from a typical case may be of interest.

A 10-in square-loop aerial was tested in a building where the noise level was fairly high and constant from nearby motors. Two different aerials were available for comparison with the loop, the first being a simple indoor aerial about 25ft long, and the second

* Danish Posts and Telegraphs.
† *Electronics*, October 1938.

Fig. 1. Various ways of coupling the loop to the receiver. In (a) a coupling transformer is used with its primary inserted in the mid-point of the loop winding. In (b) the loop itself is used as an auto-transformer. In (c) capacitive coupling is obtained with two capacitors of equal value.



an outdoor aerial of equal length on the top of the building, raised about 12ft above roof level and provided with a screened down-lead. The screen of the down-lead could be isolated from earth and from the receiver so that the condition of an elevated aerial with an unscreened down-lead was also available. With the various aerials connected, the noise level in a broadcast receiver was measured relative to a known modulation depth (40%) of the long-wave signal.

The following results were obtained :—

Indoor aerial	21db	below modulation
Outdoor aerial, unscreened	35db	" "
Outdoor aerial, screened ..	43db	" "
Loop aerial	39db	" "

As was expected, the best noise suppression was obtained from the outdoor aerial with screened down-lead, but the noise level with the indoor loop was only 4db higher and 4db better than the outdoor aerial with unscreened lead-in and as much as 18db better than the simple indoor aerial. Further experiments with the loop aerial at different locations in the building showed another advantage of this kind of aerial—which can also be proved theoretically—that the voltage pick-up from radio waves was much less dependent on the surroundings (house wiring, pipes, etc.) than the voltage measured between capacitive indoor aerials and earth, and was nearly the same in the basement and on the top floor of the building.

Inductance of the Loop

Now to the actual design of the loop. The inductance of a square loop of side-length S metres with a winding length of b metres consisting of N turns, can be calculated with approximation by the formula :

$$L_0 = 0.00184SN^2 \log \frac{2S}{b} \text{ mH} \qquad (1)$$

The self-capacitance of the winding is a rather important factor as it is generally much higher than for other receiver coils. It cannot be calculated with the same accuracy as the inductance, but for square loops with the most common values of S and b it has been found that the expression $C_0 = 60S$ pF is sufficiently accurate for our purpose.

The value of L_0 should preferably be chosen so that the Q of the loop circuit will be at a maximum near the working frequency f_0 or in the middle of the desired frequency band. It is found experimentally that this is realized when the natural frequency of the loop is about three times f_0. Therefore

$$3f_0 2\pi\sqrt{60L_0S} = 1 \text{ or}$$

$$L_0 = \frac{0.047}{f_0^2 S} \text{ mH} \quad \text{and} \quad N = \frac{5}{f_0 S\sqrt{\log \frac{2S}{b}}} \text{ turns} \qquad (2)$$

where f_0 is in Mc/s. When this loop inductance is chosen, the necessary tuning capacitance for f_0 will be roughly 480S pF.

In finding the size of wire to fill up the available winding space b, a suitable ratio of wire spacing to wire diameter must be chosen. For a given size of wire, the highest Qs are generally obtained for ratios between 0.5 and 1, but the same Q will be obtained when using a slightly heavier wire and a spacing of 2–5 wire diameters or more, which is generally more practical, especially for large loops. Measurements on a number of loops of the type shown in Fig 2, with values of S ranging from 0.2 to 0.7 and wound with 33 to 23 s.w.g. copper wire, have given maximum Qs from 130 to 170. It is not necessary to know the loop Q with great accuracy, however, and to be on the safe side it is a good idea to use Q = 100 in the calculations for loops wound with rather thin wire and Q = 150 when a heavier wire and the optimum spacing ratio are used.

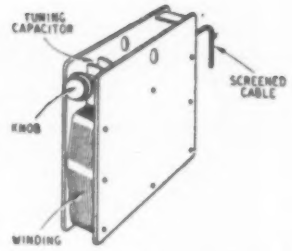


Fig. 2. Suggested method of construction with the winding and tuning capacitor mounted between two plates of hard insulating material.

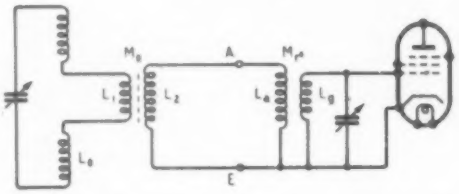


Fig. 3. Resultant circuit when the loop is connected through a transformer to the receiver input.

The size of the loop will, of course, be determined by the r.f. input voltage required at the grid of the first valve of the receiver. This in turn will depend on the coupling of the loop to the receiver, so it is necessary to consider the question of coupling first.

When the loop is used with an ordinary broadcast receiver certain precautions are necessary to prevent interference with its symmetry from the unbalanced input circuit of the receiver, while some form of impedance matching must be provided in the coupling in order that the signal voltage supplied to the receiver may be as high as possible. This requirement can be met in a number of different ways, some of which are shown in Fig. 1. In (a) the coupling element is an r.f. transformer with the primary winding inserted in the mid-point of the loop. The loop is thus isolated from the receiver, and the impedance match is effected by choosing an appropriate turns ratio for the transformer. In (b) the loop itself is used as an auto-transformer, the centre part of the winding being used as a coupling impedance with the winding mid-point connected to the earth terminal. Fig. 1 (c) shows a capacitive coupling with two capacitors connected in series and inserted at the mid-point of the loop, the receiver input circuit being shunted across one of them. Here the capacitive mid-point of the loop is earthed.

The two wires from the loop aerial to the receiver terminals must be efficiently screened to prevent their behaving as short capacitive antennas and picking up noise, and the screen must be connected to the earth terminal of the receiver.

The majority of broadcast receivers have an input circuit as shown in Fig. 3 (to the right of the A–E

terminals), with a high-inductance primary winding coupled to the tuned circuit of the first valve. Correct matching of the loop to the receiver can only be calculated when the circuit constants are known, but if they are not known the following values are fairly typical for the long-wave band: $L_a = 14$ mH, $L_g = 2.2$ mH, $M_r = 1.1$ mH, $k_r = 0.2$, $Q_g = 65$.

The complete circuit in Fig. 3 is equivalent to an inductive coupling direct between the loop and the grid circuit, with a coefficient of coupling:

$$k_{cc} = \frac{M_0 M_r}{(L_2 + L_a)\sqrt{L_0 L_g}} \qquad (3)$$

The step-up factor or magnification ratio of the two coupled circuits, defined by $A = E_g E_0$ (where E_g is the voltage across the grid circuit and E_0 the effective voltage in series with the loop), will be a maximum when the equivalent coefficient of coupling has the critical value $k_c = 1/\sqrt{Q_0 Q_g}$ and the magnification ratio will then attain the value:

$$A = \tfrac{1}{2}\sqrt{\frac{L_g}{L_0}}\sqrt{Q_0 Q_g} \qquad (4)$$

When k_{cc} is made greater or smaller than k_c the value of A will be smaller than is given in (4) but only by a small amount, and for moderate changes in k_{cc} the value of A will be nearly constant. The selectivity of the input circuit is, however, largely controlled by k_{cc}, and to avoid too much sideband cutting it may be advisable to select the ratio k_{cc}/k_c somewhat greater than unity for long-wave loops.

Calculating the Size

We return now to the question of the size of the loop. The electromotive force E_0 induced in the loop by a passing radio wave is given by:

$$E_0 = e\,\frac{2\pi S^2 N}{\lambda}\ \text{mV} \qquad (5)$$

where e is the field strength of the radio wave in mV/m and λ is the wavelength in metres. When this is put into (4) together with (1) we eventually get the following expression for the voltage at the first grid of the receiver:

$$E_g = e\,\frac{73}{\lambda}\sqrt{L_g Q_g}\sqrt{\frac{Q_0 S^3}{\log \frac{2S}{b}}}\ \text{mV} \qquad (6)$$

With the receiver constants given above, $Q_0 = 100$, $S = 10b$ and $\lambda = 1500$m (Droitwich), we then get $E_g = 5.1e\sqrt{S^3}$ in millivolts, and this gives:

$$S = 0.34\sqrt[3]{\frac{E_g^2}{e^2}}\ \text{metres} \qquad (7)$$

The field strength of the Droitwich transmitting station at a particular place can be found roughly from Fig. 4 when the distance from Droitwich is known, or the information would probably be supplied on request by the B.B.C. For the receiver input, experience shows that $E_g = 5$mV is an acceptable value, although $E_g = 2$mV can be used with a slight increase in set noise and $E_g = 10$–15mV or more in some cases may give a noticeable improvement.

Coming now to the practical aspects, the loop framework and its winding can be constructed according to materials available and personal taste, making sure not to use insulating material which will absorb moisture. Fig. 2 shows a method of construction suitable for small loops, with a winding support in the form of spacers between two thin plates of insulating material; this provides accommodation also for the tuning capacitor and the coupling components. Large loops can be made more easily in the form of a flat spiral-wound coil, which can be mounted on a brick or wooden wall having the necessary approximate orientation. Provided that a good quality supporting material is used and there are no closed metal circuits in or near the wall, no excessive losses will be introduced in this way and formula (1) can be used also for this type of coil, when S is taken as the mean side-length of the winding.

The transformer in Fig. 3 can best be realized with a small dust core preferably of the pot type, for which the coefficient of coupling, k_r, is generally between 0.8 and 0.85 when the primary is placed between the two halves of the secondary winding. The values of the inductances L_1 and L_2 can be found from (3) by substituting for M_0 the value $k_r\sqrt{L_1 L_2}$ and for M_r the value $k_r\sqrt{L_a L_g}$. We then get the following:

$$L_1 = \frac{k_{cc}^2}{k_r^2 k_1^2} \cdot \frac{L_0 (L_2 + L_a)^2}{L_a L_g} \qquad (8)$$

When the secondary inductance has been fixed, L_1 can thus be calculated, and the number of turns on the two windings determined from information supplied by the manufacturer of the core. The value of L_1 should not be more than 10% of L_0 in order to reduce its influence on loop tuning and Q_0.

In the case of direct inductive coupling, Fig 1 (b), the number of turns n from the centre of the loop can be found from

$$n = N\,\frac{k_{cc}}{k_r}\sqrt{\frac{L_a}{L_0}} \qquad (9)$$

and with capacitive coupling, Fig 1(c), the value of the coupling capacitor is given by

$$C = \frac{25}{f_0^2 L_a}\left(1 + \frac{k_r}{k_{cc}}\sqrt{\frac{L_a}{L_0}}\right)\text{pF} \qquad (10)$$

where L_a and L_0 are in mH and f_0 is in Mc/s.

If it is desired to install the loop at some distance from the receiver, a position just below the roof or well removed from the electrical installation will generally be found better than in one of the living rooms. The screened feeder may now be some 30–160ft long, and although its attenuation at this low frequency will be negligible its capacitance will

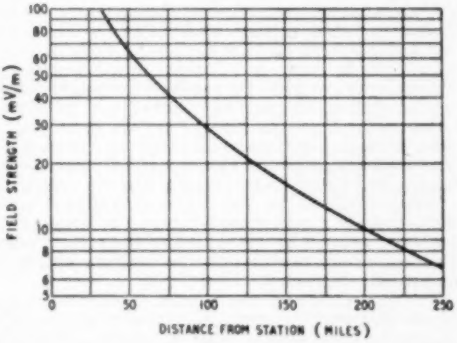


Fig. 4. Curve showing average values of field strength from the 200-kc/s Droitwich transmitter at distances from 30 to 250 miles.

have a large influence on the coupling coefficient. The effect can, however, be avoided to a large extent by matching approximately the output impedance of the loop to the characteristic impedance of the feeder cable and inserting a step-up transformer between cable and receiver for adjusting the coefficient of coupling to a suitable value. The feeder may be ordinary coaxial cable, but quite satisfactory results are given on long waves by twin screened power cable or telephone cable, which is cheaper and can easily be installed. With inductive tapping at the centre of the loop taken across n turns, the loop is matched to a feeder impedance Z_0 ohms when

$$n = N\sqrt{\frac{Z_0}{Q_0\omega L_0}} = \sqrt{\frac{0.087\,Z_0}{Q_0 f_0 S \log \frac{2S}{b}}} \qquad (11)$$

and f_0 is in Mc/s.

The equivalent coefficient of coupling between loop and grid circuit is given approximately by

$$k_{eq} = \frac{n}{N}\frac{k_1 k_r}{L_2}\sqrt{\frac{L_2 L_s L_0}{L_1}} \qquad (12)$$

where k_r is the coefficient of coupling of the receiver transformer, L_1 its primary and L_2 its secondary inductance. Formula (12) can thus be used to determine the number of transformer turns in the same way as (8). A satisfactory match is usually obtained when the value of Z_0 is chosen between 100 and 400 ohms.

When the loop aerial is completed and connected to the receiver a few tests should be made to ensure that it is working properly and that the noise reduction is the best possible. The loop tuning should present no difficulties, especially if a receiver with a visible tuning indicator is used; otherwise the loop is tuned for the best signal/noise ratio. The directional property is observed by turning the loop around its vertical axis and noting the variation in signal strength, keeping in mind that the receiver a.g.c. will keep the audio output nearly constant so that it is rather the variation in background noise which should be observed. When the distance to the desired station is more than 150 miles, it is best to work during daylight hours to avoid the effects of indirect rays. The two maxima should be equally strong, and the two minima should be quite sharp and spaced nearly 180 degrees apart. If there is much electrical wiring in the house some influence might be experienced, especially on the minima, so that if possible this test should be made on an upper floor or in the open air. When the directional property is satisfactory, the reduction of local radio noise will generally be very noticeable when the loop is compared with a simple indoor aerial. With fixed loops, where the directional effect cannot be observed so easily, the balance of the winding can be tested roughly by connecting a piece of wire a few feet long alternately to the two terminals of the loop tuning capacitor. If there is a rise in background noise from local sources this should be nearly the same in the two cases, but connecting the wire to the centre tap should have no effect.

WICK RADIO

THE first of the eleven G.P.O. coast radio stations to be refurbished under the present plan of modernization is that at Wick, Caithness, where three new transmitters operating between 400 kc/s and 4 Mc/s have been installed. Wick Radio (GKR), which was officially opened by the Assistant Postmaster-General on September 9th, provides, as do the other coast stations, radiotelegram and radiotelephone services, medical advice, navigational instructions, and, of course, a distress watch for coastal shipping.

Designed and produced by the Post Office Engineering Department, the maximum output power obtainable from each of the transmitters is 3 kW but the actual powers used for the various types of emission (which are laid down in International Regulations) are fixed by pre-set adjustments. Any one of eight pre-determined frequencies in the 415 to 515-kc/s band and the 1.6 to 3.8-Mc/s band can be selected by push-buttons on the operator's control desk. The transmitters can also be set up for telephony or telegraphy by push-button controls on the console.

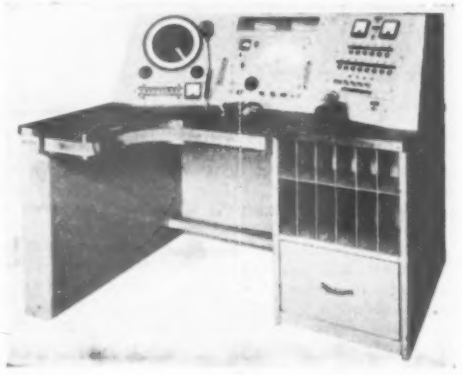
Relay circuits in the control system ensure exclusive and uninterrupted control once a transmitter has been selected by the operator, while other relay circuits prevent two or more transmitters operating on the same frequency.

For connecting the radio circuits to the inland telephone network four-wire to two-wire termination equipment is installed. This equipment includes a constant volume amplifier in the transmitter modulation path, which adjusts the speech level to that required to modulate the transmitter fully, and a voice operated device to prevent singing.

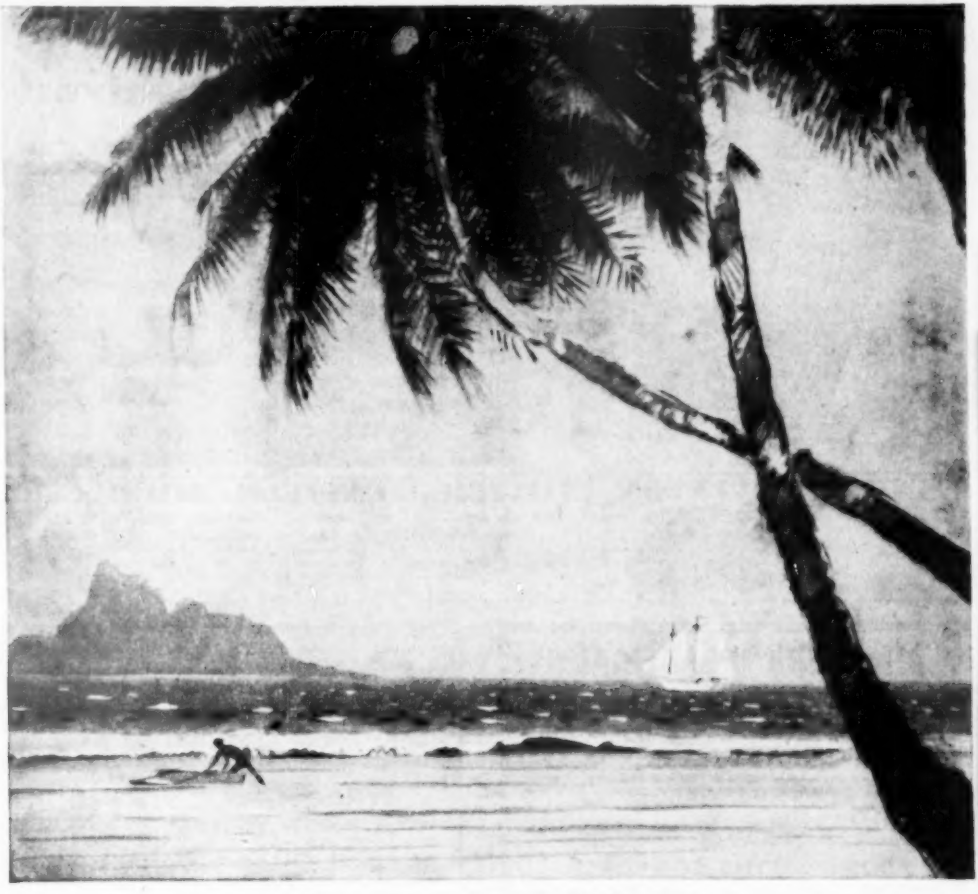
The transmitting aerials on the site include one directly connected "T" aerial shared by the transmitters operating on 415-515 kc/s, and one vertical radiator for each transmitter working in the 1.6 to 3.8-Mc/s band. The receiving aerials are located about ½-mile from the station.

In addition to the three new transmitters, Wick Radio is equipped with two transmitters operating in the 4 to 12.5-Mc/s band.

Operator's console accommodating the transmitter and radio telephone control panels, receiver and direction finder.



MARCONI communication systems



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Suspended Television Feeder

Coaxial Line with Wire-rope "Inner" at New Transmitters

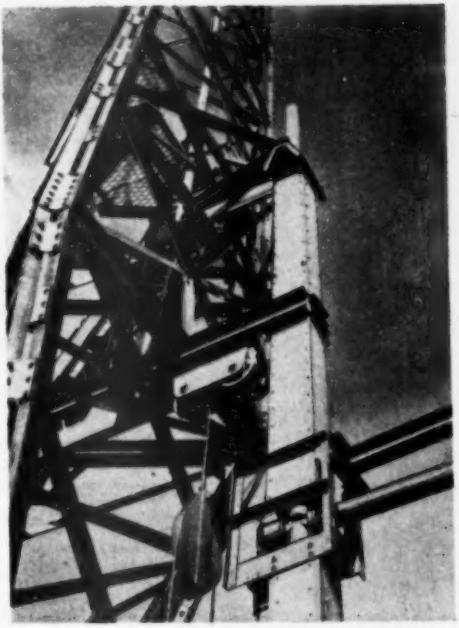
ALTHOUGH the force of gravity has been exploited in a good many different ways by engineers, it has probably never been used before as a means of improving the characteristics of a radio transmission line. That, however, is precisely what it does in the new type of aerial feeder which runs up the masts of the Kirk O'Shotts and Wenvoe television stations. Unlike the conventional system where the coaxial tubes are built into the structure of the mast (as at Sutton Coldfield and Holme Moss), this feeder is freely suspended from the top of the mast and only has anchoring points to prevent it from swinging about too much. The outer conductor is an ordinary 5-in copper tube, but the "inner" is formed by a copper-coated steel rope (1.37in diameter) located centrally by spaced insulators and held taut by a two-ton load at the bottom.

The whole idea of this system is to keep the transmission line as straight and uniform as possible and so avoid any mechanical irregularities which might cause reflections. (The conventional system is rather prone to this kind of trouble because the soft copper tubes are under compression all the time, especially at the bottom, and tend to get buckled and distorted.) Actually, the use of gravitational force in this way is a particularly happy idea because it means that the electrical uniformity tends to increase towards the top of the feeder with the increasing loading, so that the long-delay reflections arising at this end (the most troublesome ones) tend to be of smaller amplitude.

A rather special kind of wire rope is used for the inner conductor. It is constructed on the locked-coil principle (as used in colliery winding) and has the property of being mechanically "dead"—that is, it is free from distortion and will not rotate or unravel when supporting a load. Its real strength lies in a central core of galvanized steel wires; this is surrounded by a layer of copper wires partially locked together, with another layer of shaped and completely locked copper strands on top. Because of the way these outer strands fit into each other, the surface of the rope is substantially smooth.

The "outer" is constructed of 12-ft sections of copper tube, which are bolted together by flanges having tongued-and-grooved faces to permit accurate alignment. One flange on each section also serves as a housing for three ceramic-rod insulators, which are adjusted from the outside so that they touch the wire-rope "inner" and hold it central.

In Fig. 1 is a simplified drawing of the complete feeder and suspension system The feeder itself is 681 ft long and weighs 2.82 tons without the two-ton load. Expansion couplings are necessary to allow for the difference in expansion between the "inner" and the "outer" and for the expansion of the complete system relative to the fixed continuation of the feeder on the ground. It will be noted that the main vertical section is short - circuited at both ends. The feed-in and feed-out junctions, however, are made at points a quarter-wavelength in from the ends, where the short circuits have produced high parallel impedances. This arrangement would be quite satisfactory as it stands on a single frequency, but as a band of frequencies has to be transmitted, two short-circuited quarter-wave stubs are



View from the bottom of the mast at Kirk O'Shotts, showing how the feeder is led in. The pulleys are part of the loading mechanism.

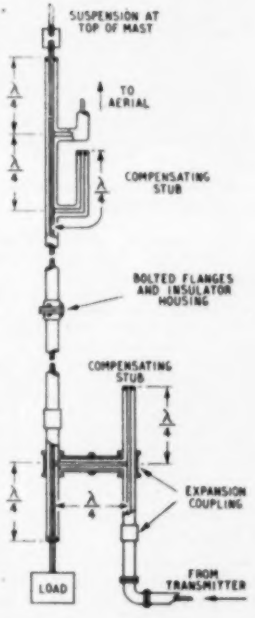


Fig. 1. Simplified drawing of the complete feeder and suspension system.

added to cancel the effects of the short-circuited quarter-wave end sections. As can be seen, these are spaced at a quarter-wavelength from the junction points. The characteristic impedance of the feeder is approximately 80 ohms.

Apart from the improvement in electrical uniformity, another great advantage of this type of feeder (supplied, incidentally, by Electrical & Musical Industries) is the ease with which it can be erected. The wire-rope "inner" is delivered on a drum and is simply hauled up the mast like an ordinary cable, then sections of the copper-tube "outer" are threaded on to it, hauled up and bolted together at the flanges.

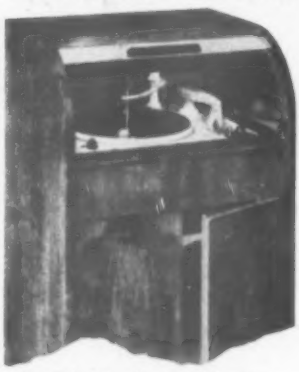
Manufacturers' Products

NEW EQUIPMENT AND ACCESSORIES FOR RADIO AND ELECTRONICS

Console Record Player

A RANGE of console-style record players has been introduced by Richard Allan which for all practical purposes convert an ordinary table model receiver into a self-contained radio-gramophone. This is achieved by providing a flat space on top for standing the receiver.

The top compartment contains the gramophone equipment and when not in use it is closed by a roll-top lid. The lower part forms a capacious storage cupboard for records



Richard Allan floor model gramophone record player.

and is closed by two doors hinged at the sides and is attractively finished in figured walnut.

A choice of 19 different models is available and they include single and three-speed types also mixer and non-mixer auto-changers and many different types of pick-up heads, including magnetic, lightweight, turn-over, crystal and microgroove, among others.

Prices range from about £24 to £44 and the makers are Richard Allan Radio, Ltd., Taylor Street, Batley, Yorkshire.

Miniature Dual-purpose Coils

THE latest range of Denco "Maxi-Q" miniature coils are wound on distinctively coloured low-loss formers with adjustable dust-iron cores and designed for optional single-hole chassis mounting or as plug-in coils, using a noval (B9A) valve-holder. The colours indicate the function of the coil. A full set covers 3.8 to 2,000 metres, tuning capacitors of 0.0003 μF being recommended down to 9.5 metres and of 50 pF for the shorter wavelengths.

Denco "Maxi-Q" miniature r.f. transformer with reaction winding.

Many of the coils are interchangeable in superhet and t.r.f. circuits and there are oscillator coils for i.f.s. of 465 kc/s or 1.6 Mc/s. On the two shortest ranges, covering 3.8 to 10 metres, an i.f. of about 5 Mc/s can be used if desired with existing oscillator coils.

Coils measure approximately 2 in high overall and $\frac{3}{4}$ in diameter at the base ring carrying the pins. The body of the former is $\frac{1}{4}$ in diameter.

The makers are Denco (Clacton), Ltd., 355-9, Old Road, Clacton-on-Sea, Essex, and prices range from 3s 11d to 4s 9d each.

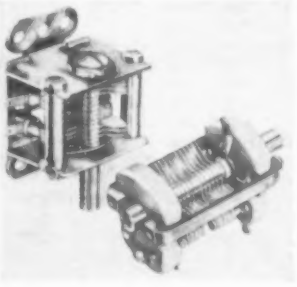
Split-stator Capacitors

TWO split-stator variable capacitors for use in v.h.f. equipment have been introduced by Jackson Bros. (London), Ltd., Kingsway, Waddon, Surrey. One, Type C808, for panel mounting, is fitted with ceramic end-plates, silver-plated brass vanes and is secured to the panel by two screws.

The other, Type U101, is for mounting on a chassis or baseboard and has silver-plated brass vanes supported on ceramic insulators in a cadmium-plated steel frame with the rotor electrically connected to the frame. Both types are avaiable in various capacitances up to 43 pF each section.

Type C808 costs 10s 6d and the chassis-mounting model, U101, 10s 9d.

Jackson v.h.f. split-stator capacitors; type C808 for panel-mounting and type U101 for mounting on a chassis.



Sub-miniature Potentiometer

APART from its obvious use in hearing aids a sub-miniature potentiometer has many applications in various kinds of miniaturized radio equipments, small personal portables being one example. The tiny "Belclere" component illustrated is a product of John Bell & Croyden, 117, High Street, Oxford, and it measures $\frac{5}{8}$ in only in diameter, is $\frac{1}{2}$ in thick and weighs $\frac{1}{2}$oz. In addition to containing a 3-contact potentiometer it also houses a single-pole on-off switch. Four tags only are used and the fifth needed to give complete isolation of the two items is formed by using the centre fixing screw as the moving contact of the potentiometer. The outside drum forms the control knob and is rotatable.

Resistance tracks of logarithmic or linear law are available and the standard resistance values are 3-6MΩ in the former and 1 MΩ in the later types, but alternative tracks are

Sub-miniature "Belclere" volume control with on-off switch.

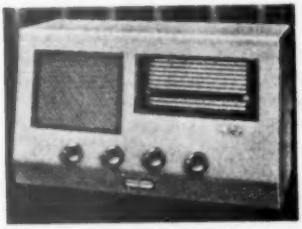
available to order. The switch capacity is 100 mA at 50 V maximum.

The standard finish is a black case with white figures round the edge forming a scale, but other requirements can be met by arrangement.

Cabin Broadcast Set

A BROADCAST receiver on a ship has to contend with the most exacting conditions, for not only will it be exposed to wide changes in temperature and humidity, and most likely get a lot of buffeting in bad weather, but withal it has to give a good performance on short waves.

The Cameo Senior (Model RM1) introduced by Rees Mace has been designed for this kind of service. It possesses 9 ranges in all, one long-wave, one medium and seven short. Of the short, two have a fairly wide coverage, e.g., 31 to 67 and 65 to



Rees Mace Cameo Senior, Model RMI, cabin broadcast receiver.

203 metres, while five have limited coverages centred on 13, 16, 19, 25 and 31 metres respectively.

Four miniature valves are used in a more or less conventional superhet circuit, which is arranged for a.c./d.c. operation on electric supplies of 100 to 125 and 200 to 250 volts. A valve rectifier supplies h.t. and the components have been chosen to withstand tropical conditions.

Wide-range tone control, easily readable scales, functional rather than ornate appearance, constitute some additional features of this set.

The makers are Rees Mace Marine, Ltd., 11, Hinde Street, London, W.1, and the price is £19 10s plus purchase tax in U.K. of £10 8s.

Home-produced "Crackle" Finish

IT has hitherto been necessary to bake, or stove as it is called, the particular kind of enamel that produces the characteristic hard crystalline surface known as "crackle." It is now claimed that the same results can be obtained with a new air-drying enamel.

According to the instructions the enamel is applied with a brush in the usual way and left to dry in a very slightly contaminated atmosphere. Only a minute trace of impurity is needed and a small gas jet, such as the pilot flame of a gas cooker, is sufficient. Alternatively a small oil lamp or even the old-fashioned night-light can be used. The enamel will not "crackle" in perfectly pure air.

The enamel can be applied to most materials, in addition to metal, and takes well on stout paper and similar material. Supplies of the enamel, which is black in colour and known as "Panl," are obtainable from L. Miller, 8, Kenton Park Crescent, Kenton, Middlesex.

Valve Retainers

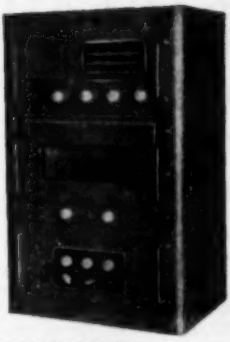
MOST valves sooner or later tend to work out of their sockets unless restrained in some way; for mobile equipment valve retainers of one kind or another are virtually a necessity.

Retainers take various forms, but those made by Electrothermal Engineering are of the kind that hold the valve in position by some form of cap, or harness, fitting over the valve and having springs secured to the valveholder, or other convenient anchorage.

A few examples are shown in the illustration, where are seen a dished top-cap type of all-metal construction for miniature valves with B7G bases, a loop-type retainer for larger valves having a shoulder on the envelope and a harness-type for shoulderless valves. Some other types are shown in the foreground.

Tension springs do not contact the valve and that portion which embraces the bulb, except in the dished metal type, is made of glass-fibre cord, said to be rot, insect and fungus proof and suitable for use in tropical as well as temperate zones. The maker's address is 270 Neville Road, London, E.7.

Specimen types of Electrothermal valve retainers.



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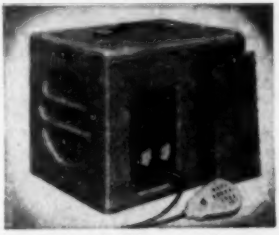

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RANDOM RADIATIONS

By "DIALLIST"

Gas Fitters Again!

DO YOU REMEMBER my referring recently to the habit some gas fitters have of lightheartedly running their pipes alongside the lead covering of the conduits of the electric wiring of our houses? A Scottish reader sends me an account of the way in which radio reception, not only in his own flat, but in every one of the block in which he lives, was affected by contact between a gaspipe and a number of lead-sheathed electric pairs. For some time all sets in the building had been subject to fairly frequent outbursts of noisiness and to occasional 50 per cent reductions in signal strength. Having noticed that the noisiness could be produced by treading lightly on a loose floor-board and that a heavier tread brought about a general reduction in volume, he concluded that the electric wiring must be to blame and decided to make a thorough investigation. He began in the attic, which contained the majority of the wiring for the flats, and having "tortured all the junction boxes in sight" without result, he was moved to lift a gaspipe, laid casually on top of several lead sheaths. He'd found the clue! By making the pipe vibrate gently and establishing intermittent light contact with the lead sheaths he could cause the wireless sets to become noisy; the reduction to half signal strength could be produced by bringing the pipe firmly into contact with the sheathing. Under loose floor-board in his own flat a similar instance of carefree "plumbing" was found. He's wondering why and how the effects observed were caused.

Noisiness

It isn't difficult to see how the light intermittent contacts gave rise to noisiness. The sections of a gaspipe may be pretty well insulated from one another by the sealing compound used at the joints; in that case only those bits of it which are buried in the ground or are in firm contact with things such as ascending water mains are held down at earth potential. Others may build up static charges of quite a few volts owing probably to the effects of friction between molecules of gas and the inner walls; I have seen small arcs occur when a gaspipe and the lead covering of electric wires were brought close together. The discharges taking place when the rather dirty gaspipe came lightly into contact with the also rather dirty lead sheathing would be quite sufficient to set up mains-borne noisiness. At the moment, though, I don't quite follow why firm contact between pipe and sheathing should cause a big drop in the volume from all the sets; but there is a possible explanation. Assuming that the lead sheathing is well and truly earthed, the result of such a contact should be the temporarily effective earthing of a section of the gaspipe. That suggests that this may be one of those queer cases of pick-up by a section (or sections) of the gaspipe, detection at one (or more) of the joints and re-radiation. In that case the gaspipe might be responsible for pushing up the volume of the receiver and there would be a marked falling off when it was earthed. I wonder whether my correspondent could find time to make an experiment: with a pipe and the sheathing well separated by means of, say, a dry piece of wood, connect a pair of headphones between them and see if anything is heard.

Do You Interlace?

BEING POSSESSED of an enquiring mind, I have made a little investigation into interlacing, as it is carried out by domestic television receivers. The B.B.C.'s transmissions are perfectly interlaced, the odd-numbered and even-numbered scanning lines being evenly and equally spaced. To do justice to these transmissions, the receiver must regularly produce a similar raster. But does it? The results of my little investigation were surprising—or were they . . .? They showed that a number of the lower-priced sets, as delivered and installed, and as operated by non-technical users either don't interlace, or do so imperfectly. It's not at all difficult to make a test. The transmitted image consists of 377 "active" scanning lines, the remaining 28 of the 405 being devoted to the frame sync pulses and the inter-frame blackouts. Hence, any area one inch in height of the received image should contain $377/h$ *evenly spaced* lines, where h is the height of the screen image in inches.

Interlapping and Overlacing

Even when you're dealing with a big image the number of lines in a single inch of height to be counted and examined for equal spacing is rather formidable; it's easier, therefore, to work with an area half an inch in height—or even a quarter of an inch. To enable the eye to concentrate on a particular small area of the image and not to be distracted by other parts of it, a mask of opaque paper or thin cardboard should be made, which can be held against the screen. Measure the height of the image; then rule and cut out in the mask a square window with sides equal to 1/30 that height. It should really be 1/29, or 1/13, since 29

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and 13 are the only factors of 377; but that would be too fiddling a job. Now place the window over, say, a portion of the Test Card C pattern where the lines are easy to see. If the set is interlacing perfectly, there should be 12 or 13 evenly spaced lines in the window. Too often there aren't and what is taking place is described by a friend of mine as "interlapping and overlacing."

Viewing and Listening

AT THE MOMENT holders of television licences are outnumbered about eight to one by those licensed to receive sound only. It is officially estimated that in the not so distant future the position will be reversed and that perhaps 10 to 15 years from now, the television receiver will be as common an article of domestic equipment as is the broadcast receiver to-day. Probably the great majority of viewers have also a means of receiving the purely sound programmes. It is, therefore, very difficult to discover whether television is replacing sound, or whether it is now merely supplementary to it. For what it is worth, my experience is that when the television set first comes into the home it ousts the sound receiver at all times when vision programmes are available. Thereafter, viewing gradually becomes more and more selective. Only certain televised items are watched and the sound receiver tends to take a greater part in the home entertainment.

In the Future

Some years from now it is probable that all items — except, possibly, foreign news—will be broadcast for aural and visual reception, and I foresee the receiving equipment of the fairly near future as a combined sound and vision set, provided with a switch enabling vision plus sound, or sound alone to be received. Some sets may have arrangements for the reception of vision only, for one can think of televised items that would be more welcome without sound. Unless and until some entirely new method of television transmission is invented, I do not for a moment believe that vision-plus-sound programmes will entirely replace sound only as home entertainment. People vary greatly as regards the length of time they can spend with their eyes glued to the screen. Were vision programmes available all day, most set owners would in all probability be grateful for some means of hearing the sound alone.

The Choice of Critics

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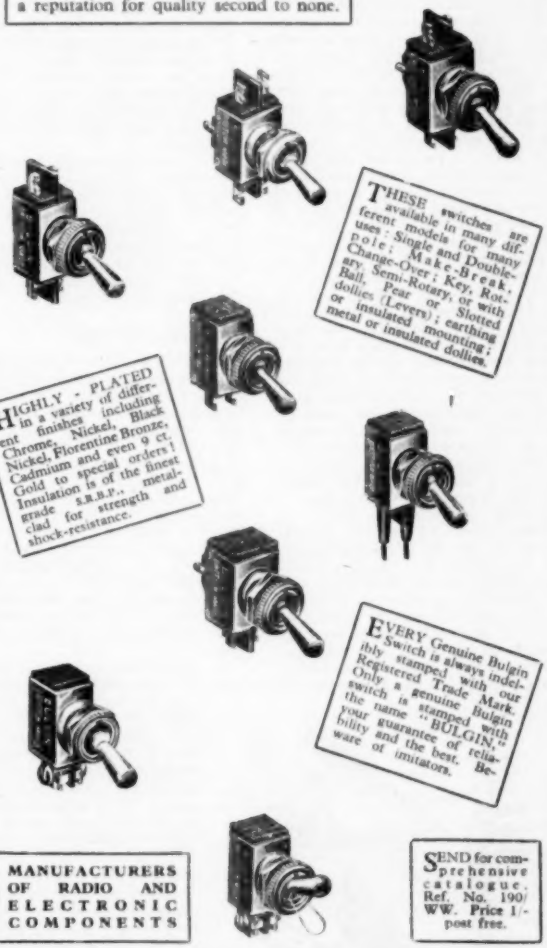

THESE switches are available in many different models for many uses: Single and Double-pole; Make-Break, Change-Over; Key, Rotary, Semi-Rotary; or with Ball, Pear or Slotted dollies (Levers); earthing or insulated mounting; metal or insulated dollies.

HIGHLY-PLATED in a variety of different finishes including Chrome, Nickel, Black Nickel, Florentine Bronze, Cadmium and even 9 ct. Gold to special orders! Insulation is of the finest grade S.R.B.P., clad for strength and shock-resistance.

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BYE-PASS ROAD BARKING

UNBIASED

By FREE GRID

The Age of Wisdom

THIRTY years is the age at which a man is considered to have attained a sufficient degree of wisdom to be made a bishop, and back in 1922, when regular broadcasting began in this country, no woman was considered to have sufficient sense to be allowed a vote or to sit in Parliament until she had attained that age. This establishment of thirty years as the age at which wisdom begins is undoubtedly a psychologically sound thing. I have, in fact, often thought that this country's divorce rate would be decimated if men were forbidden by law to marry before they were thirty years old. By that time they would have learned to choose their life partners with the same care that they lavish on the choice of a car—by looking at the engine instead of being sidetracked by streamlined bodywork which is the undoing of the inexperienced in both cases.

Now my youthful readers will wonder what all this has got to do with wireless. The older ones will recollect, however, that on November 14th we shall be celebrating the B.B.C.'s thirtieth birthday, and they wonder, as I do, whether, now that it has attained the age at which it should have cut its wisdom teeth, the Corporation will begin to show some signs of mellowness and maturity. There is at least one B.B.C. reform which is long overdue, about which I have previously written and now suggest a simple technical means whereby it could be carried out.

Briefly, I want the B.B.C. to eliminate the annoyance of one having to jump up like a jack-in-the-box to operate the volume control each time a talk or other quiet item is followed by a brass-band concert or vice versa. It could be done quite easily without the control engineer turning up the wick for talks and turning it down again for orchestral items as this would, of course, be anathema to music lovers.

All that is needed is that transmitters should emit special signals according to the nature of the item being broadcast. When a talk is followed by a brass band or other din producer this signal will operate a relay in our sets controlling a simple "on-off" type of volume control. Straightforward enough, isn't it? Of course, we musical Philistines who don't know a crochet from a quaver—and don't want to—would have to pay for the relay to be put into our sets and that we would gladly do.

No doubt set manufacturers would be pleased to help us as it would provide a new selling point for their wares. Naturally the device would have a manually operated cut-out switch for use when we were entertaining musical friends who like the furniture-rattling racket of Sousa in full blast.

Bedlam Barred

THE citizens of Coventry have always been in the van of progress since the day Lady Godiva anticipated the seaside fashions of the present age by appearing in ultra-Bikinis. It is now the City's Lighting Engineer who assumes the mantle of Lady Godiva—figuratively speaking, of course—by prophesying that lamp-posts of the future will carry a radio receiver so that each lamp can be controlled by a transmitter in the Street-Lighting H.Q. I gather from the words of the learned engineer that this radio control method has many advantages over other systems, including that of cost.

I cannot help drawing a parallel with the idea which, as reported in both the lay and the technical Press, the Ministry of Transport has under consideration for enabling a fire engine to turn all traffic lights in its favour as it clangs its way through the streets. This scheme proposes the fitting of each set of lights with an acoustically operated switch worked by a screaming siren on the fire engine.

Screaming sirens are, of course, very necessary in cities like Chicago in order that they may be heard above the pandemonium which is the normal acoustic condition there, compared with which the peak-hour noise of Piccadilly sounds like one of the more somniferous passages of Gray's "Elegy."

Streamlined bodywork.

Reducing canine casualties.

To my mind, a far better method is one which I saw on the Continent and reported in this journal nearly fifteen years ago (*W.W.*, December 2nd, 1937) in which traffic lights were fitted with an e.h.f. receiver operated by a transmitter of very limited range fitted to fire engines, ambulances and police cars. Doing its work silently and unobtrusively, this system would not turn our streets into a bellowing Bedlam as would the acoustic method the Ministry is reported to be considering.

The use of a radio frequency for this purpose may be considered wasteful and, if so, I would suggest as an alternative that a supersonic frequency of about 20,000 c/s be used. This, although beyond our hearing, would have the advantage of being audible to dogs, who would soon learn to recognize it as a danger signal, making it advisable for them to keep out of the way. I know what I am talking about as I have a supersonic horn (in addition to the normal one) fitted to my car and permanently switched on when the engine is running. This has been of immense benefit in reducing canine casualties when Mrs. Free Grid is driving.

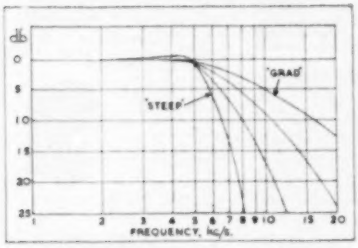
Magnetic Molars

NO doubt you will have read of the latest developments in American dentistry whereby permanent magnets are embedded in the gums to hold artificial teeth which presumably have an iron core. We all know that watches are demagnetized by putting them in a magnetic field and that the same wipe-out principle is used in our tape recorders. If the alternating field be made strong enough it will demagnetize the most "permanent" of magnets, and there seem possibilities here for a politician literally to draw his rival's fangs at a meeting by the installation of suitable apparatus under the platform beforehand, thus rendering him speechless.

A RADICALLY NEW PRE-AMPLIFIER FOR LEAK 'POINT-ONE' POWER AMPLIFIERS

The

"Vari-Slope"



Frequency amplitude curves for the "TREBLE—3" position (5 kc/s turnover). Curves of the same slopes are obtained on the other two positions turning over at 7 kc/s and 9 kc/s ("—2" and "—1" positions).

The filters consist essentially of twin-T resistor-capacitor networks inserted in the return circuit of a single-loop feedback amplifier. The more obvious advantages of this electronic feedback method over conventional choke filters include :—

(a) Improved transient response characteristics (due to absence of chokes having self-capacitance) and the consequent reduction of "ringing."

(b) Extremely low harmonic and inter-modulation distortion due to negative voltage feedback action.

(c) No discontinuities in the rates of slope when the slope control is operated, and no change in signal level at frequencies below turnover. (Both these faults occur in variable-slope choke filters due to the slope control altering the terminating impedance and the insertion loss.)

(d) There are no chokes to cause magnetic hum pick-up.

(e) Smaller size, lighter weight, greater uniformity in production.

AUDIBLY BETTER REPRODUCTION

from unique

FEEDBACK CIRCUIT DEVELOPMENT

The new "Vari-Slope" pre-amplifier has a refinement which will doubtless set the pattern for future high-fidelity reproducing amplifiers. This advance consists of variable-slope "electronic" low-pass filters operating on negative voltage feedback principles.

No Inductors ("Chokes") are used, and all their disadvantages are completely eliminated. The turnover frequencies are 5kc/s, 7kc/s, and 9kc/s and the slopes of attenuation are continuously variable over the range 5db to 50db per octave.

PRICE **£12-12-0** LIST
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TO BRITISH USERS OF THE
RC/PA/U PRE-AMPLIFIER

Your old model can be rebuilt as a standard "VARI-SLOPE" at a charge of £8.8.0.

Orders will be booked in rotation.

Please do not send your pre-amplifier to us until we advise you of a date.

OVERSEAS USERS should contact their national agent regarding the availability of this rebuilding service, which is dependent on freight and reimport duties being reasonably low.

Write for "Vari-Slope" Leaflet

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BREAK-DOWN UNIT

At present day prices the spares in this unit would cost at least £5. Here is a list of the main contents:

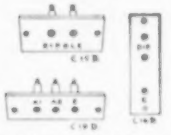
3 two-metre coils;
3 tuning condensers, split-stator type;
4 two-watt carbon resistors, useful values;
1 tapped 20 watt resistor, vitreous covered;
6 paper condensers, .05 mf. 1,000 v. working;
3 paper condensers, .1 mf. 1,000 v. working;
2 H.F. chokes;
4 paper condensers, .1 mf. 450 v. working;
2 paper condensers, .15 mf.
5 bakelite moulded mica condensers .001;
1 paper condenser, .01 mf. 3,000 v. working;
24 rubber grommets, assorted sizes;
6 resistors 1 watt, all useful values;
6 resistors ½ watt, all useful values;
40 resistors ¼ watt, all useful values;
40 silver mica condensers assorted values, including: 10, 15, 20, 40, 50, 100, 150, 300 and 500 pf. types;
4 English octal valve holders;
2 English 5-pin valve holders;
1 E.F. 50 type valve holder;
3 diode valve holders;
1 louvred casing, 12 × 7 × 4in., with chassis to fit.
8 condenser clips, assorted sizes.

Also an assortment of nuts, bolts B.A., self-threading screws, tag boards, chassis mounting tag connectors, screened grid caps, plain grid caps, levers, rollers, connecting rods, output sockets, etc., etc.

ALL THIS COLLECTION OF PARTS FOR 6/6 only, plus 1/9 postage and packing.

SUNDRIES

SOCKET STRIPS. Paxolin mounted.



Two socket engraved L.S. 6d. each. Bin. C16B.
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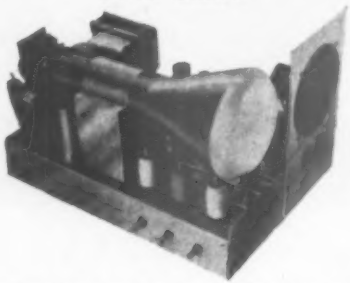
Four socket engraved A.E. Pickup. 9d. each. Bin. C19E.

WHAT'S WRONG FOR £5

A conventional radio receiver of the superhet type suddenly stops playing, on preliminary investigation by touching the top caps of all the valves no resultant sounds are heard in the loudspeaker at all—the set is dead. One thing is noticed, however, and that is that the output valve has lighted up like a beacon. What is the fault? Prizes of £5, £3, and £2 will be sent to the first three correct entries opened on November 29th.

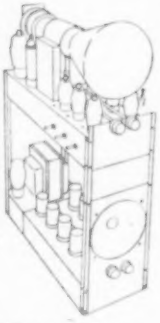
THE "P.T." "ARGUS" TELEVISION RECEIVER

A 21 Valve 6in. C.R. Tube Unit-built Televisor for the Amateur



Although this televisor costs only about £20, it does not involve the conversion of ex-Government units, and has been designed for construction by the novice. The circuits have been kept straightforward and devoid of "frills," though nothing has been sacrificed which would assist in its efficient and stable operation.

The cathode-ray tube used is a VCR97. This 6in. tube was chosen as it is readily available at a low cost, and is capable of providing pictures of very good quality. The trace is green, but one soon becomes accustomed to the colour, and it is very restful to the eyes.



The chassis is divided into five separate units which makes for ease of construction; the units are vision receiver; sound receiver; time base; E.H.T. Supply and C.R.T. network and power unit. Each unit is complete on its own chassis, and when finished all units are bolted together to form the complete televisor.

We can supply all the parts for £20/10/3 H.P. terms are available, deposit being £6/17/-, balance 12 monthly payments of £1/6/6 each. Carriage and packing 10/- extra.

A reprint of the data which originally appeared in "*Practical Television*," together with some additional diagrams and notes produced by our Television engineers are available as a constructor's Envelope. Price 5/-, post free.

THE ARGUS ARRANGED AS A CONSOLE →

MAGNETIC TAPE RECORDER KIT—YOURS FOR £9/15/-

Total cost, £29/5/- or £9/15/- deposit.
Cabinet only, £4/17/6.
Tape Deck only, £16/10/-.

Tape Deck. Fitted with 3 motors giving fast rewind/forward run and no friction. High fidelity record/playback giving approximately 1 hour playing from standard 1,200ft. tape. Tape, 35/- per reel.

Amplifier. High gain enables recording to be made from microphone pick-up, or loudspeaker. Separate bass and treble lift controls.
Cabinet. Portable, is rexine covered, table model is polished walnut.
Instruction Booklet. Shows in close detail exactly how to assemble and operate the recorder, is free with kit or available separately at 5/- (credited if you buy kit or complete recorder).

Price £29/5/-. Complete kit of parts including 6 B.V.A. valves, loudspeaker and cabinet (state whether portable or table model required) or £9/15/- deposit and 12 monthly payments of £1/18/-. If desired we will assemble and test for £4 extra. Suitable crystal microphone, £1/15/- extra.

TRANSFORMER BARGAINS

250 mA, 350-0-350 v., 6.3 v. at 6 amps, 5 v. at 3 amps, 4 v. at 5 amp. Price 37/6.

200 mA, 425-0-425 v., 6.3 v. at 4 amps, 6.3 v. at 4 amps., 5 v. at 3 amps. Price 50/-.

120 mA, 350-0-350 v., 4 v. at 4 amps C.T., 4 v. at 2 amps C.T. Price 42/6.

100 mA, 350-0-350 v., 6.3 v. at 4 amps, 5 v. at 3 amps, fully shrouded upright mounting. Price 22/6.

100 mA, 250-0-250 v., 6.3v. at 6 amps, 5 v. at 3 amps, fully shrouded upright mounting. Price 27/6.

85 mA, 350-0-350 v., 4 v. at 2.5 amps C.T., 4 v. at 5 amps C.T. Price 37/-.

80 mA, 350-0-350 v., 0-4-6.3 v. at 5 amps, 0-4-5 v. at 2 amps. Price 19/6.

80 mA, 300-0-300 v., 6.3 v. at 4 amps C.T., 5 v. at 2 amps upright mounting. Price 19/6.

80 mA, 280-0-280 v., 4 v. at 1.5 amps, 4 v. at 6 amps, half shrouded. Price 18/6.

70 mA, 235-0-235 v., 6.3 v. at 2.5 amps. 5 v. at 2 amps, upright mounting, price 22/6. 70 mA, 235-0-235 v., 4 v. at 4 amps, 4 v. at 1 amp, upright mounting. Price 22/6.

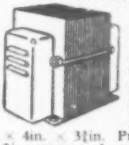
60 mA, 260-0-260 v., 4 v. at 3 amps, 4 v. at 2 amps, upright mounting fully shrouded. Price 18/6.

40 mA, 325-0-325 v., 6.3 v. at 3 amps, upright mounting. Price 15/6.

FILAMENT TRANSFORMERS

Standard types for receivers, 6.3 v. at 1.5 amps. Price 6/6. 6.3 v. at 2 amps. Price 8/6. E.H.T. insulated. 2 v. at 2.5 amps. Price 7/6.

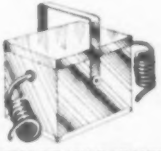
T.V. TRANSFORMERS



Fixed Primary—H.T. Secondary, 300-0-300 v. at 150 mA, L.T. 7.5-0-7.5 v. at 3 amps and 4v. at 3 amps. Dimensions are 4¼in. high × 4in. × 3¼in. Price 17/6, plus 2/- postage and packing.

E.H.T. TRANSFORMERS

2,500 v. 5 mA, 2-0-2 v., at 1.1 amps. 2-0-2 v. at 2 amps. Price 37/6.



WELDING TRANSFORMERS

12 v. 50 amp output from 200-240 v. A.C. mains.
Primary and secondary separated by a special screen to prevent interference, this screen is brought out to the terminal block. Complete in metal case with carrying handle, price £4/5/-, plus 5/- carriage and packing.

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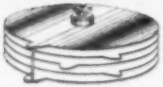
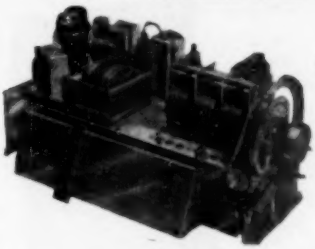


The one illustrated is a special bargain being available at considerably below cost. It is a selenium type rectifier rated at 12 v. 2½ amps, it is of course a full wave type highly suitable for battery chargers. Limited quantity. Price 17/6 each.
Also available 6 v. 1 amp. Type Price 5/- each. 12 v. 1 amp. Type. Price 9/- each.

7 VALVE 5 WAVEBAND RADIO CHASSIS



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£8 . 19 . 6

A famous set by a famous manufacturer. Undoubtedly a serious listener's receiver. Among many special features are a H.F. stage and tuning indicator. Tunes up to 11 metre-band. Price complete with valves but less speaker. **£14/19/6.** H.P. Terms, £5/-/- deposit and 12 monthly payments of **19/6.**
We have a few left, less valves and power packs, otherwise in good condition they definitely have never been used. Price, **£6/19/6.** H.P. Terms, **£2/7/-** deposit and eleven monthly payments of **10/-**, plus 15/- carriage.

500-W. PORTABLE HEATER

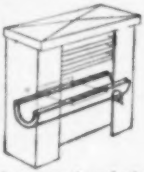
Made by G.E.C. for the Navy, waterproof and almost indestructible, safe in the garage or other inflammable atmospheres. Price 25/-, plus 2/6 post and pkg.

STILL AVAILABLE TAX FREE.

ROOM HEATER / CLOTHES DRIER

Chrome plated clothes drier room heater dries and airs washing, towels etc. Ideal for flats, hotels, hairdressers etc. Works off A.C. or D.C. mains only 650 watts. (State voltage). Size 3ft. × 3ft. × 5in. Made to sell at **£12/12/-**. Price **£4/19/6**, plus 7/6 carriage.
H.P. Terms, **£1/14/0** deposit and eight monthly payments of **10/-**.

MAKE A CONVECTION HEATER



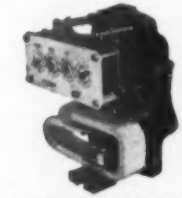
Using Ex-Admiralty HEATING UNITS fitted with 3 pin brass plug and socket. Copper-clad enclosed elements are used and those again are enclosed in sheet metal half cylindrical containers. Fit one of these into a metal cabinet, and you have an excellent convection heater. In places where appearance is not important, all you need extra is the wire as the heaters work perfectly well as they are, without extra casing the actual elements being totally enclosed.

PRICES

2 K.W. 220/230 v.	12 0
500 W. 220/230 v.	12 0

Carriage 5/- extra per heater.

Sketches and details of suitable cabinet are supplied with each heater. 2 K.W. 110 v. heating units are also available at 7/6 each. There are ideal working in series for greenhouse heating, etc., or for space heating under benches, etc. Eight of these in series will consume 1 K.W. and will spread the heat out over a wide area.



STAND BY BATTERY SET

Made originally for the Government for use in canteens, etc., this 4 valve medium waveband superhet uses 2 v. Mazda valves, and is complete with 5in. PM speaker and usual controls. Unused but storage soiled. Price **75/-**.

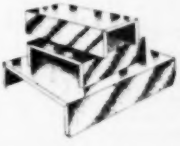
FERRANTI ELECTRIC METER MOVEMENT

A complete check meter except for case, brand new and unused. Has many uses, one for instance in that of telling the numbers of hours a piece of apparatus has worked. Price is only **17/6**, post etc. 2/-.

BLANK CHASSIS

18 S.W.G. Aluminium

7 × 3½ × 2 ..	5/-	16 × 10 × 3 ..	8 3
9½ × 4½ × 2½	5 9	16 × 8 × 3 ..	8/-
10 × 8 × 2½ ..	7/-	11½ × 10 × 3	7 6
10 × 5½ × 2½	6 6	16 × 12 × 3 ..	8 8
10 × 9 × 3 ..	7 3	19½ × 9 × 2½	8 3
12 × 9 × 2½ ..	7 3	20 × 10 × 3 ..	10/-
14 × 9 × 2½ ..	7 6	21½ × 9⅝ × 2½	10 6
14 × 10 × 3 ..	8/-		



PROFESSIONAL RADIOS YOU CAN MAKE

You will find that the building of our all-mains radio receivers is simplicity itself, and the more you make the less time each takes, everything down to the last nut and bolt is supplied, and everything fits together in a professional manner. When finished the receiver looks and plays as well as those being offered in radio shops at anything between £10 and £14. The one illustrated above we call "The Occasional" in a choice of colours. Ivory, Walnut or Green, and the T.R.F. costs just less than £6 to make, while the superhet costs approximately £9.
The other radio illustrated we call the "White Lady" this is an extra fine cabinet of pure white. The complete T.R.F. receiver costs about **£6/5/-** to build and the superhet receiver costs about **£9/5/-** to build. Constructional data for either set is available at 1/6 post free.

UNSPILLABLE ACCUMULATORS

Very best make clear celluloid case. Size 4¼ × 2¼ × 3½in. 11 Amphour. Price **14/6.**

MIDGET EXTENSION SPEAKER

3½in. moving coil speaker in bakelite cabinet with metal grill and black fitted with terminals, size 4½in. × 4½in. × 2in. Ideal as desk extension or for bedroom, kitchen, etc. Also makes good microphone. Price **18/6**, or cabinets only **6/6.**

SOMWEAVE

This really lovely loud-speaker fabric we offer at approximately a third of today's cost. It is 42in. wide and our price is 12/- per yard or panels 12in. × 12in., 1/9 each. This is also very suitable for covering plain wooden cases, for portable radio amplifiers, etc.

"SNIPERSCOPE"

Famous wartime "cats eye" used in conjunction with a lens system and h.t for seeing in the dark. This is an infra-red image converter cell with a silver caesium screen which lights up (like a cathode ray tube) when the electrons released by the infra-red strike it. It follows that as light from an ordinary lamp is rich in infra-red these cells will work burglar alarms, counting circuits, smoke detectors and the hundred and one other devices as will the simpler type of photo cell. Here then is a golden opportunity for some interesting experiments, price **9/6** each, or six for **52/6.** Data will be supplied with cells if requested.

CLIX 15 AMP. FOOT PLUG

Made to B.S.S. specification, shuttered in moulded bakelite case, **1/6** each.

Advertisement of Electronic Precision Equipment Ltd.

EX-GOVERNMENT VALVES

We carry large stocks of Government valves and invite enquiries for all types. Here are brief details of just a few of our varied stock. The one illustrated is the high current thyratron CV1147 which has a peak plate current of 12 amps, this we can supply at the extremely low price of 20/-.

RECTIFIERS. Note figures given are peak rating. CV1504 60 KV., 1,200 mA, £5 17/-. CV74 40 KV., 600 mA, £2 17/6. CV1111 14 KV., 350 mA, 4/3. CV1120 14 KV., 40 mA, 4/3. CV54 7 KV., 400 mA, 6/6. CV1508 8 KV., 1,000 mA, 17/6. Note we are told this is a good substitute for the GU21, also we have a few of these with loose bases otherwise new and perfect, 12/6.

MERCURY RECTIFIERS

CV1029 2 KV., 2.5 amps. 9/6. BD10 1 KV., 25 amps., £6 10/-.

MISCELLANEOUS TYPES

The following are also available and we shall be glad to give further information of price and quantity to customers wanting these types. Others are available in smaller quantities, please state your special needs.

CV12	CV187	CV1051	CV1137
CV13	CV188	CV1053	CV1139
CV18	CV193	CV1054	CV1141
CV19	CV210	CV1055	CV1147
CV20	CV271	CV1056	CV1152
CV22	CV321	CV1057	CV1170
CV31	CV327	CV1060	CV1175
CV32	CV534	CV1061	CV1187
CV37	CV594	CV1061A	CV1191
CV43	CV619	CV1062	CV1197
CV45	CV621	CV1065	CV1199
CV51	CV634	CV1066	CV1284
CV53	CV640	CV1074	CV1300
CV54	CV656	CV1075	CV1303
CV57	CV659	CV1078	CV1310
CV63	CV665	CV1090	CV1311
CV65	CV668	CV1091	CV1366
CV67	CV686	CV1092	CV1367
CV71	CV702	CV1094	CV1368
CV72	CV704	CV1095	CV1449
CV73	CV755	CV1101	CV1481
CV74	CV773	CV1102	CV1054
CV82	CV779	CV1104	CV1503
CV85	CV781	CV1105	CV1573
CV92	CV849	CV1106	CV1653
CV93	CV852	CV1107	CV1755
CV115	CV895	CV1108	CV1913
CV117	CV922	CV1110	CV1943
CV118	CV1000	CV1111	CV2539
CV120	CV1018	CV1118	CV2579
CV129	CV1020	CV1120	CV2679
CV133	CV1023	CV1124	CV2710
CV138	CV1025	CV1125	CV2941
CV147	CV1029	CV1126	CV2945
CV148	CV1031	CV1127	CV3581
CV158	CV1032	CV1128	CV3793
	CV1033	CV1129	
CV160	CV1035	CV1133	
CV177	CV1037	CV1135	
CV185	CV1047	CV1136	

METAL DIVIDERS

Really well made for Government workshops. Ideal for marking out on metal chassis. Price 3/6.

RADIO GRAM CABINET

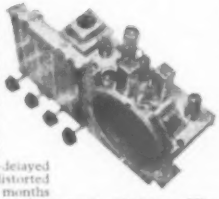
Console Type Cabinet. With full grained walnut finish, will take standard type auto change gram unit. Price, £11/10/-. H.P. Terms, £3 17/- deposit, and 12 monthly payments of 15/-, plus 15/- carriage.

Radio Chassis to suit. £8/19/6. H.P. Terms, £3/-/- deposit and 10 monthly payments of 11/6, plus 7/6 carr.

Auto Change Units. For long playing and standard records with suitable pick-up head, £11/11/-.

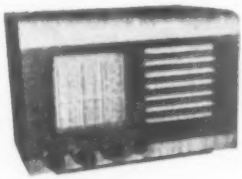
SPECIAL OFFER. Cabinet, Radio Chassis and Auto Changer, £32. H.P. Terms, £10/14/- deposit and 12 monthly payments of £2/1/6.

THE SUPERIOR FIVE



A.C. mains superhet built by one of our famous manufacturers—Covers long - wave 800 - 2,200 metres, Medium-wave 200-500 metres and Short-wave 16-50 metres. Made on heavy gauge chassis, size 15½in. × 8in. × 2½in., edge-lit dial, printed and calibrated in three colours, size 7½in. square 8in. P.M. speaker two speed tuning—B.V.A. valves types, 6K8, 6U7, 6R7, 6V6, and 6X5—Pick-up and speaker sockets—delayed A.V.C.—I.F. Filter—4 watts undistorted output—circuit diagram and 12 months written guarantee. Price complete ready to work, **£10/19/6. Hire Purchase Terms £3/14/-** deposit then 12 monthly payments of 14/-. Non-callers please add 10/6 to cover carriage and insurance.

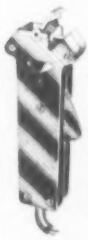
SPECIAL OFFER. Radio Chassis and Cabinet as described below, **£14/2/6.** H.P. Terms, £4/16/6 deposit and 12 monthly payments of 18/-.



SUPERIOR CABINET

With beautifully veneered full grained and highly polished finish, dimensions 19in. wide 10in. deep × 12½in. high. This cabinet will take our "Superior Five" also the set being advertised by Messrs. Lasky's Radio.

In this cabinet the set will look well worth **£18-£20.** Price **3 gns.** each, post, packing and insurance 7/- extra.

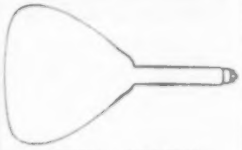


STANELCO WIRE JOINTER

This jointer melts the twisted wires and causes the metal of each to run together, thus making a strong and permanent weld. It obviously is not intended to replace the soldering iron but nevertheless is ideal for making joints that have, for instance, to withstand heat, vibration chemical action, etc. In many cases also this method is faster than soldering and there is usually a considerable saving of current. Price 9/6.

CRYSTAL MICROPHONE SNIP

Highly suitable for Tape Recorder, users claim this best yet. Uses Cosmocord diaphragm driven insert, in bakelite case, very flat for going under the lid of portable recorder. Price 35/- limited stock.



SPECIAL PURPOSE CATHODE RAY TUBE

Long Persistence

Type No.	Diam. in ins.	Filament Volt.	Filament Current
VCR.85	11.5	4v.	1 Amp.
VCR.511/B	11.75	4v.	1 Amp.
VCR.528	11.5	4v.	1 Amp.

A limited quantity of these are available.

EX-GOVT. CATHODE RAY TUBES

Note: All these tubes have green fluorescence.

VCR97. Brand new and unused, these are not the "cut-off" type. Gives full picture. Price 42/6. Carriage and insurance 5/- extra.

SCP1. 5in. electrostatic, American manufacture — medium persistence, suitable for T.V. or 'scope, in original cartons, 39/6, carriage and insurance 2/6.

4/1 3in. Electrostatic 15/-, plus 2/6 carriage, etc.

VCR139A. 2½in., 37/6, plus 2/6 carriage, etc.

VCR138. 3½in. electrostatic short persistence, suitable for T.V. and ideal for 'scope work. 27/6, plus 3/6 carriage, etc.

VCR112. 5in. electrostatic, persistence not known, 22/6 each, plus 5/- carriage, etc.

CV996. 6in. electrostatic, persistence not known, 22/6 each, plus 5/- carriage, etc.

— AMERICAN VALVES —

2B26	807	8011
2C34	813	DET12
4C27	830B	DET19
5D6	832	RK20A
6J6	860	RK28A
35T	866	RKR72
54 Gram-matron	866A	RL5
259A	923	RL7
714AB	954	RL18
717A	1616	RX235
723AB	1625	TZ0520
801	1629	VT90
803	4064B	VT114
805	4074B	VTX3
	4328A	WE3A

UNBREAKABLE GLASS

Is a parcel of toughened glass which we can offer at approximately a quarter of its cost. This glass, as many readers will know, can be dropped and will not break. In fact it is most difficult to break and is so useful for dozens of applications in addition to its original purpose of protecting viewers against flying glass in the event of an exploding Cathode Ray tube.

We offer a parcel of five panels each 10½ × 9½in. for 7/6 post free.

Advertisement of Electronic Precision Equipment Ltd.

PICK-UP BARGAIN
Lightweight microcell crystal P.U. with interchangeable heads for long playing and standard records, ideal to modernise old gram. Permanent sapphire stylus, beautiful finish, **54/-**, post and insurance 2/- with 2 heads and arm rest.

12 CELL ACCUMULATOR
This accumulator can be coupled up to give 24 v. with all cells connected in series or 12, 6 or 2 volts in series parallel arrangements. They were originally made for the Admiralty by a leading manufacturer, have never been filled, and are in excellent condition. Each is contained in a wooden crate as illustrated. Post and insurance 2/6. Price 27/6.

SPADE TERMINALS

C20A
Heavy duty, fit ex-Government car batteries, **9d.** each. Bin C20A.

GRAM UNIT SNIP
Collaro AC501, with turntable, auto stop/start and hi-fi pick-up, new and perfect, **£4/19/6** and 3/6 post and packing.

SLIDER RESISTORS

Heavy Duty Type.
Size 7in. × 1¼in. 11 ohms 4.5 amp. 22/-; Size 9in. × 1¼in. 1.2 ohms 15 amp. 15/-; Size 13¼in. × 1¼in. 3 ohms 10 amp., 15/-.

FREE—T.V. SERVICE SHEETS—FREE

The supplement to a new publication "Television Faults" contains complete circuit diagrams, component values technical descriptions etc., of 6 popular T.V. receivers as follows:

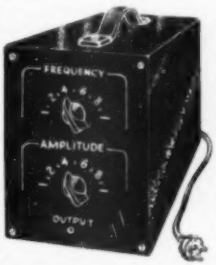
Baird Everyman, T.29; Murphy, V.120C; English Electric, 1150M; Phillips projection model 704A and 1800; Marconi VT.53DA Ultra V.711.

The book itself in the introductory chapter tabulates over 60 common faults from complete failures to such troubles as shadows in the corner. Against each fault symptom is given probable causes and a reference to the part of the book where more detailed information can be found. Following the quick fault finding guide are 10 chapters, each giving typical circuits and data indicating the actual components likely to be at fault.

The book is invaluable to novice and experienced T.V. serviceman alike because it contains a wealth of practical experience. Priced at only 5/-, it will undoubtedly save its cost the first time you have to refer to it. Order now to ensure getting the free supplement.

T.V. SIGNAL AND PATTERN GENERATOR

Cost of all components valves etc. only 29/6.



Although this generator can be built and used by any beginner it is at the same time a most useful instrument for the more advanced worker.
It can be tuned to the vision channel and will produce a pattern on the face of the C.R. tube. Alternatively if tuned to the sound channel it will produce an audible signal in the loudspeaker.
Thus its owner will become independent of B.B.C. transmissions and can fault-find or test at any time. It operates entirely from A.C. mains and is quite suitable for use with superhet or straight receivers.
A complete kit of parts (in fact everything except the cabinet) with full constructional and operational data will be supplied for **29/6**, plus 2/6 post and insurance, alternatively data is available separately, price 2/6 (credited if you buy the kit later).

NOTE. Cabinets as per the illustrated prototype will be available shortly

THIS MONTH'S SNIP

15" Magnetic Television Tube by very famous maker, as used in many popular television receivers (list on request). New with written guarantee, offered at approximately half price:

£12 - 10 - 0 each
plus 10/- carriage and insurance.

Limited quantity so order immediately
(SMALL DEPOSIT SECURES)

CONNECTING WIRE SNIP
P.V.C. insulated 23 s.w.g. copper wire in 100ft. coils, 2/9 each. Colours available: Black, Brown, Red Orange, Pink, Yellow, White, Transparent. 4 coils for **10/-**.

REMOTE CONTROL With only one pair of wires and a simple push button you can select any one of four stations without leaving your armchair. This is just one of the many applications of our impulse relay. There are many other purposes to which it can be put. Note they are somewhat soiled due to storage but mechanically O.K. Price 2/6.

AERIAL STRAINERS
Brass body, price 1/6 each.

SITUATIONS VACANT

At our new Harrow Wealdstone premises we shall require a few departmental managers and we invite applications from "Wireless World" readers.
Applicant should have a detailed knowledge of some group of radio components as well as a good knowledge of Radio and T.V. parts generally.
He should also be a practical technician reasonably well educated, able to promote business, to prepare advertising, sales leaflets, catalogue, etc. Finally he must be able to recruit and control his own team of assistants and must command respect befitting his position.
The right man will have the opportunity to earn upwards of £15 per week after a very short period.
Apply in first instance by letter to Departmental Manager, E.P.E. Ltd., Ruislip

ELECTRONIC PRECISION EQUIPMENT LTD.

The building you see alongside is our new Mail Order Depot at Harrow. We have not been able to move in yet however due to delays over licences, etc. Therefore until further notice, please continue to address Post Orders to E.P.E. Ltd. (Dept. 2), Windmill Hill Ruislip, Middx. Also note, we are not giving up any of our shop premises, so personal shoppers please call at:—

42-46, WINDMILL HILL, RUISLIP, MIDDX.
(Half-day Wednesday)

152-153, FLEET STREET, E.C.4.
(Half-day, Saturday).

Terms C.W.O or C.O.D. No C.O.D. under £1. Postage 1/- extra under £1, 1/6 extra under £3.

RADIO SUPPLY CO.

15 Wellington Street, Leeds 1 Tel. 22153

Open to callers: 9 a.m. to 5.30 p.m. Saturdays until 1 p.m.
FULL PRICE LIST 5d.
TRADE LIST 5d.
Please enclose S.A.E. with all Enquiries

COLLARO AUTOMATIC RECORD CHANGERS Latest 3-speed Type 3RC511, complete with Dual Purpose Crystal Pick-up, for standard or Long-playing Records. Machine takes 9 records 10in. or 12in., not intermixed. Overall size 15×12½in. Height above Motor Plate 4½in., below 2½in. **PRICE ONLY £11/11/-**, inc. tax. Carr. 5/- extra. (This is approx. 25% below current list price.)

SPECIAL OFFERS. Midget Mains Transformers (size approx. 2½-3-3in.); drop-through chassis type. Screened primary 220/240 v. 50 c/s. Outputs 250-0-250 v. 60 mA, 6.3 v. 2.5 a. Suitable for 6×5 rectifier and up to 4 other valves. Only **10/6**. Small Filament Transformers 220-240 v. input, 6.3 v. 1.5 a. output **5/6**. New boxed ex-Govt. valves VR126 (4 v. 7-pin H.F. Pentode), **1/9** each.

BATTERY SET CONVERTER KIT. All parts for converting any type of Battery Receiver to A.C. mains 200-250 v. 50 c/s. Kit will supply fully smoothed H.T. of 120 v. 90 v. or 60 v. at up to 40 mA, and fully smoothed L.T. of 2 v. or 1.4 v. at 0.9 to 1 amp. Price complete with circuit only **45/6**.

H.T. ELIMINATOR & TRICKLE CHARGER KIT. Consists of h.t. and l.t. transformers, h.t. and l.t. rectifiers, smoothing electrolytic and choke, adjustable charger resistor. For Mains 200-250 v. Supplied complete with circuit. Only **29/6**.

H.T. ELIMINATOR KIT consisting of Mains Transformer (200-250 v. input), smoothing choke, metal rectifiers, Electrolytic 30 + 50 mfd., tapped adjustable Resistor, Chassis and Circuit. Unit will supply a maximum of 120 v. 40 mA. For A.C. Mains 200-250 v.. Price **21/9**.

BATTERY CHARGER KITS
To charge 6 or 12 v. acc. at 3 a., **29/6**.
To charge 6 or 12 v. acc. at 4½ a., **45/-**.
Above consists of transformer, bridge rectifier and adjustable resistor. Circuit supplied.

COAXIAL CABLE, 75 ohms, ½in., **11d.** yd.

DIAL BULBS, M.E.S., 6.5 V 0.15 A, 8 V 0.15 A, **5/9** dozen.

NEW EX-GOVT. VALVES

6K8G.T	5/11	12H6 Met.	1/11
7Y7	6/9	12SH7 Met.	5/9
9D8	1/11	OZ4	7/9
VU120A	2/9	PF50	6/6
4SH	7/6	VT61A	1/11
MHL136	9/6	RK34	1/11

ELECTROLYTICS (Current production. Not ex-Govt.):

Tubular Types		Can Types	
8μF 350 V	1/9	24μF 350 V	2/11
8μF 450 V	1/11	32 mfd 350 V	3/3
8μF 500 V	2/9	32μF 450 V	4/3
16μF 350 V	2/3	40μF 450 V	4/3
16 mfd. 450 V	2/9	50μF 350 V	4/9
16μF 500 V	3/9	8-8μF 450 V	3/11
24μF 350 V	3/3	8-8 mfd 500 V	4/9
32μF 350 V	3/3	8-16μF 450 V	4/6
8-16μF 500 V	4/11	16-16μF 450 V	4/11
25μF 12 V	10d.	16-16 mfd 500 V	5/9
25μF 25 V	1/3	16-32μF 350 V	4/11
25-25 mfd 25 V	1/9	32-32 mfd 275 V	3/11
25 mfd. 50 V	1/9	32-32μF 350 V	4/11
50 mfd 25 V	1/9	32-32μF 450 V	5/9
50μF 12 V	1/3	50-50μF 350 V	5/11
50μF 50 V	2/3	50-50μF 450 V	5/9
250 mfd 12 V	10d.	16-32 mfd 450 V	5/9

CAN TYPES

32-32-8μF 350 V (small)	5/11
16-16-8 mfd. 475 V	5/9
16-16 mfd. 450 V plus 20 mfd. 25 V	5/3
32-32μF 350 V plus 25μF 25 V	5/11
50μF 350 V plus 250μF 12 V	4/11

CHASSIS, 16 swg. Undrilled Aluminium. Receiver Type 10×5½×2in., **3/9**; 11×6×2½in., **4/3**; 12×8×2½in., **5/3**; 16×8×2½in., **7/6**; 20×8×2½in., **8/11**; Amplifier Type (4 sided), 12×8×2½in., **7/11**; 16×8×2½in., **10/11**; 14×10×3in., **12/6**; 20×9×3½in., **13/6**.

ALUMINIUM PANELS. 18 s.w.g. 18×12in., **5/6**; 18×18in., **8/3**.

SILVER MICA CONDENSERS. 5 pfd., 10pfd., 15 pfd., 20 pfd., 25 pfd., 30 pfd., 35 pfd., 50 pfd., 120 pfd., 150 pfd., 180 pfd., 300 pfd., 230 pfd., 300 pfd., 330 pfd., 400 pfd., 470 pfd., 500 pfd., 1,000 pfd. (.001 μF), 200 pfd. (.002μF). All at **5d.** each. **3/9** dozen one type.

TUBULAR WIRE-ENDED CONDENSERS. (New Stock.) .001 mfd., 750 V, .002 mfd., 750 V., .003 mfd., 750 V, .005 mfd., 500 V, .01 mfd. 750 V, .05 mfd., 450 V, 1 mfd., 350 V, .25 mfd., 350 V, .5 mfd., 350 V. All at **4d.** each, **3/3** doz. one type, **27/6** gross.

CABINETS, BAKELITE (Brown or White) or **WOOD** (Walnut veneered). Size approx. 12×6½×5in. Very attractive appearance. Supplied complete with fully punched T.R.F. 3-valve Chassis, back, 2 or 3 wave. Glass scale with coloured station names. Dial Backplate. **25/-**, plus carr. 2/6. All parts available for construction of T.R.F. or superhet receiver in above cabinets.

CLEARANCE LINES. .0005 mfd. 2-gang variables **4/6**. Vol. controls, Midget, 1 meg. with long spindle and S.P. switch, **2/9**. Standard 25 K with 1in. spindle and D.P. switch, **2/9**.

EX-GOVT. BLOCK PAPER (MANSBRIDGE TYPE) CONDENSERS.

4 mfd. 500 V working	ea.	2/9
8 mfd. 500 V working	ea.	4/9

EX-GOVT. ITEMS. Pye coaxial plugs and sockets, **7/6** doz. prs. Belling-Lee moulded type 5-pin and 10-pin plugs and sockets, **1/11** pr. Int. Octal Valve Screening Cans, 3 piece, **1/3** ea., **11/9** doz. 02 mfd. 5,000 v. B.I. Tubulars, **1/9**. Coil Formers ½in. with slug, **3/9** doz.

EX-GOVT. SMOOTHING CHOKES

Potted Types	
330 mA 5 H 50 ohms	12/9
220 mA. 5 H 50 ohms	10/9
150 mA 10 H 200 ohms	9/6
100 mA 15 H 200 ohms	9/6
50 mA 50 H 1,250 ohms	9/6
Tropicalised Types	
75 mA 8-10 H 200 ohms	4/6
50 mA 50 H 1,000 ohms	4/6

R.S.C. MAINS TRANSFORMERS

Fully Guaranteed, Interleaved and Impregnated Primaries

200-230-250 V 50c/s Screened

TOP SHROUDED, DROP THROUGH

250-0-250 V 70 mA, 6.3 V 2 A, 5 V 2 A, Midget type 2½-3-2½in.	15/6
260-0-260 V 70 mA, 6.3 V 3 A, 5 V 2 A	14/11
260-0-260 V 80 mA, 6.3 V 2 A, 5 V 2 A	14/11
350-0-350 V 80 mA, 6.3 V 2 A, 5 V 2 A	17/9
350-0-350 V 90 mA, 6.3 V 3 A, 5 V 2 A	21/9
250-0-250 V 100 mA, 6.3 V 4 A, 5 V 3 A	23/9
300-0-300 V 100 mA, 6.3 V 4 V 4 A, c.t., 0-4-5 V 3 A	23/9
350-0-350 V 100 mA, 6.3 V 4 V 4 A, c.t. 0-4-5 V, 0-4-5 V 3 A	23/9
350-0-350 V 120 mA, 6.3 V 4 A, 5 V 3 A	28/9
350-0-350 V 150 mA, 6.3 V 4 A, 5 V 3 A	29/11
350-0-350 V 150 mA, 6.3 V 2 A, 6.3 V 2 A, 5 V, 3 A	29/11

CLAMPED UPRIGHT MOUNTING

250-0-250 V 80 mA, 6.3 V 3 A, 5 V 3 A	17/9
350-0-350 V 100 mA, 6.3 V 2 A, 5 V 2 A	21/6

FULLY SHROUDED UPRIGHT

250-0-250 V 60 mA, 6.3 V 2 A, 5 V 2 A, Midget type 2½-3-3in.	17/6
350-0-350 V 70 mA, 6.3 V 2 A, 5 V 2 A	18/9
250-0-250 V 100 mA, 6.3 V 4 V 4 A, c.t., 0-4-5 V 3 A	25/9
250-0-250 V 100 mA, 6.3 V 6 A, 5 V 3 A, for R1355 conversion	29/9
300-0-300 V 100 mA, 6.3 V 4 V 4 A, c.t., 0-4-5 V 3 A	25/9
350-0-350 V 100 mA, 6.3 V 4 V 4 A, c.t., 0-4-5 V 3 A	25/9
350-0-350 V 150 mA, 6.3 V 4 A, 5 V 3 A	33/9
350-0-350 V 150 mA, 6.3 V 2 A, 6.3 V 2 A, 5 V 3 A	33/9
350-0-350 V 160 mA, 6.3 V 6 A, 6.3 V 3 A, 5 V 3 A	48/9
350-0-350 V 250 mA, 6.3 V 6 A, 4 V 8 A, 0-2-6 V 2 A, 4 V, 3 A, for Electronic Eng. Televisor	67/6
425-0-425 V 200 mA, 6.3V 4 V 4 A c.t., 6.3 V-4 V 4 A, c.t. 0-4-5 V 3 A, suitable Williamson Amplifier, etc.	51/-
425-0-425 V 250 mA, 6.3 V 6 A, 6.3 V 6 A, 5 V 3 A	66/6
325-0-325 V 20 mA, 6.3 V 0.5 A, 6.3 V 1.5 A, for Williamson Preamplifier	17/6

E.H.T. TRANS. 2,500 V 2-0-2 V 1.1 A, 2-0-2 V 1.1 A, for VCR97, etc. 27/6

FILAMENT TRANSFORMERS
All with 200-250 V 50 c/s primaries: 6.3 V 2 A, **7/6**; 0-4-6.3 V 2 A, **7/9**; 12 V 1 A, **7/11**; 6.3 V 3 A, **10/11**; 6.3 V 6 A, **17/6**; 0-2-4-5-6.3 V 4 A, **16/9**; 12 V 3 A or 24 V 1.5 A, **17/6**; 0-5-6.3 V 5 A, four times, giving up to 24 V 5 A up to 12.6 V 10 A, up to 6.3 V 20 A, by series or parallel connections, **55/-**.

CHARGER TRANSFORMERS
All with 200-230-250 V 50 c/s Primaries: 0-9-15 V 1.5 A, **13/9**; 0-9-15 V 3 A, **16/9**; 0-9-15 V 6 A, **22/9**; 0-4-9-15-24 V 3 A, **22/9**; 0-9-15-30 V 3 A, **23/9**.

SMOOTHING CHOKES

250 mA, 8-10 H, weight 12 lb.	16/9
250 mA, 3 H, 50 ohms	8/9
200 mA, 5 H, 200 ohms	7/6
100 mA, 10 H, 200 ohms	7/6
80 mA, 10 H, 350 ohms	5/6
60 mA 10 H, 400 ohms	4/11
50 mA 500 H, 1,000 ohms	9/11
40 mA 5 H, 150 ohms	3/6
1 A .25 H, L.T. type	4/9

ELIMINATOR TRANSFORMERS

Primaries 200-250 V 50 c/s, 120 V 40mA	7/11
120-0-120 V 30 mA, 4 V 1 A	12/9

OUTPUT TRANSFORMERS

Midget Battery, Pentode 66 : 1 for 3S4, etc.	3/9
Small Pentode, 5,000Ω to 3Ω	2/11
Standard Pentode 5,000 ohms to 3 ohms	4/9
Standard Pentode, 8,000Ω to 3Ω	4/9
Multi ratio 40 mA, 30 : 1, 45 : 1, 60 : 1, 90 : 1, Class B Push-Pull	5/6
Push-Pull 10-12 Watts 6V6 to 3Ω or 15Ω	10/9
Push-Pull 10-12 Watts to match 6V6, etc., to 3-5-8 or 15Ω	10/9
Push-Pull 15 Watts to match 6L6, etc., to 3Ω or 15Ω Speaker	22/9
Push-Pull 20 Watts, High Quality, sectionally wound, 6L6, KT66, etc., to 3, 7.5 or 15 ohms (Secondary in 4 sections of 3.7 ohms each)	51/9
Williamson type exact to author's spec.	85/-

WE CAN QUOTE FOR QUANTITIES OF STANDARD OR SPECIAL TYPES. S.A.E. PLEASE WITH ALL ENQUIRIES.

MAINS TRANSFORMERS

All 200-250 volts c.p.s. primary. Finest quality, fully guaranteed.

MBA/3. 350-0-350 v. 80 mA, 6.3 v. 4 a., 5 v. 2 a. Both filaments tapped at 4 volts. An ideal replacement trans. Price **18/-**

MBA/5. 350-0-350 v. 125 mA, 6.3 v. 4 a., 5 v. 3 a. With mains tapping board. Price **27/6**

MBA/6. 350-0-350 v. 100 mA, 6.3 v. 3 a., 5 v. 2 a. With mains tapping board. Price **22/6**

MBA/7. 250-0-250 v. 80 mA., 6.3 v. 3 a., 5 v. 2 a. Both filaments tapped at 4 volts. Price **18/-**

AT/3. Auto transformer. 0-10-120, 200-230-240 volts, 100 watt. Price **17/6**

AT/4. Auto transformer. 100 volts and 230 volts. Step up or down. 60 watts. Price **9/6**

METAL RECTIFIERS

6 v. 1 a.	6/9
6 v. 4 a.	17/6
12 v. ½ a.	3/11
12 v. 1 a.	8/6
12 v. 4 a.	17/6

UNISELECTOR SWITCHES

8 Bank 42/6

TEST PRODS. Fused, with fully retractable points. Price 4/11 per pair.

SUPERHET COIL PACKS. 3 Wavebands: 12-35 metres; 35-100 metres; 200-550 metres. Size: 4 × 4 × 3in. Price **16/-**.

HAYNES RADIO COMPONENTS

A large range available from stock. Send us your requirements.

TWO-GANG TUNING CONDENSERS .0005MFD.

No. 1. Miniature. With Perspex dust cover and trimmers. Size: 1¾ × 2 × 1⅝in. ¼in. spindle
LASKY'S PRICE **8/6**

No. 2. Midget. With trimmers. Size: 2¼ × 1⅞ × 1⅝in., ¼in. spindle.
LASKY'S PRICE **8/6**

No. 3. Midget. With one trimmer. Size: 2¼in. × 1⅝in. × 1⅝in. ¼in. Spindle.
LASKY'S PRICE **7/6**

No. 4. Standard type. Size: 2½ × 2½ × 1⅝in., ¼in. spindle.
LASKY'S PRICE **6/6**

THREE - GANG TUNING CONDENSER. .0005 mfd. Size 3½ × 2⅞ × 1⅝in., ¼in. spindle.
LASKY'S PRICE **7/6**

TABLE MICROPHONE STANDS

Two section chrome plated. Crackle finished base
LASKY'S PRICE **15/-**

TRIMMERS AND PADDERS

All values up to 100 pF. Paxolin 6d. each, 5/- per doz. Ceramic 9d. each, 7/6 per doz. 350 pF and 550 pF, 1/- each, 10/6 per doz.

A Large range of Garrard and Collaro Auto Changers in stock. For immediate delivery.
Single-speed Garrard. From **£9/19/6**
3-speed Garrard. From **£13/19/6**

P.M. LOUDSPEAKERS

All less o'trans. new and unused. First quality.

3in.	12/11
5in.	12/6
6½in.	13/6
8in.	15/-
10in.	25/-
12in.	75/-

CARBON POTENTIOMETERS

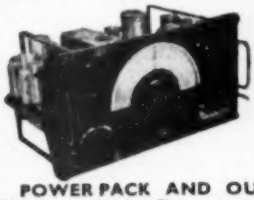
All with long spindle, ¼, ½, 1 and 2 meg.
LASKY'S PRICE **3/3** less switch, each.
With switch 4/3 each. All post extra.

LASKY'S RADIO
World Renowned for Service & Reliability

SPECIAL OFFER

BRAND NEW AND UNUSED R1155 RECEIVERS
AERIAL TESTED BEFORE DESPATCH
THESE SETS ARE THE TOPS

Supplied complete with 10 valves. Circuit: B.F.O., A.V.C., R.F. Amp., two I.F. Stages, magic eye, etc., etc. 5 Frequency ranges: 18.5-7.5 Mc/s.; 7.5-3.0 Mc/s.; 1, 500-600 Kc/s.; 500-200 Kc/s.; 200-75 Kc/s.



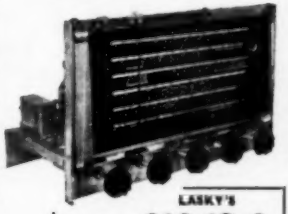
LASKY'S PRICE
£11 . 19 . 6
Carriage 12/6 extra.

POWER PACK AND OUTPUT STAGE.
Fully assembled. For use with above receiver. Complete with valves, wired and working. For operation on 200-250 volts 50 c.p.s.
LASKY'S PRICE **79/6** carriage 5/- extra.
IF PURCHASED WITH R1155.
SOLD SEPARATELY. PRICE **99/6**. carr. 5/- extra.

BRAND NEW 9-VALVE CHASSIS
SUPERHET

★ Bandspread tuning on all bands. ★ R.F. stage. ★ 6 Wave bands, Medium and S short. ★ Variable treble-cut tone control. ★ Switched bass lift. (On both gram and radio). ★ Gram input sockets. ★ Push-pull output, 6 watts. ★ Magic eye. ★ Large dial, 6 colours. ★ A.C. Mains 100-250 v. 50 c.p.s. ★ Latest type valves. ★ By famous manufacturer. ★ Frustrated South African export order (Medium wave band calibrated in metres, with South African station names.) ★ Fully assembled, wired and aligned. ★ All valves and components fully guaranteed.

Write for full details, illustrations, and circuit diagrams.



LASKY'S PRICE **£14.19.6**
Complete with all valves, knobs and circuit diagrams. (Loudspeaker extra.)
Carriage, packing and insurance 17/6 extra.

WEARITE TYPE 550 I.F. TRANSFORMERS. Permeability tuned. 445-520 Kc/s. Size: 3¼in. high, 1¾in. square. **Price 12/6**, per pair.

MIDGET YAXLEY SWITCHES. 4 pole 3 way and 2 pole 5 way. Long spind'e. **Price 2/11** each.

P.A. SPEAKERS. Re-entrant horn, 10 watts, beam projector, weatherproof speakers. 15 ohm impedance. Horn diameter—14in.
LASKY'S PRICE **99/6**
Spigot mounting 10/- extra. Carriage and packing 15/- each.

TANNOY PRESSURE UNITS. 10 watts. 7.5 ohms impedance.
LASKY'S PRICE **89/6**
Carriage 4/6 extra.

EXTENSION SPEAKERS. 3in. P.M. Complete with cabinet. Medium walnut veneer. Modern and pleasing design. Ideal for radio extension and intercom. slave units. Fitted with back. **PRICE 21/-.** Postage 2/- extra.

5-VALVE ALL-WAVE RADIO CHASSIS
BRAND NEW AND UNUSED. Fully assembled and wired. Ready for use. Not a kit, but a factory-built job. Fully aligned and tested. Features include: 5 new valves; 8in. P.M. speaker; Variable tone control; Large 7½in. square edgelit dial; 2-speed tuning, with nylon drive; 4 watts output; Sockets for p.u. and extension speaker; 465 Kc/s. I.F.; A.V.C.; Circuit diagrams.
LASKY'S PRICE £10/19/6
Complete with all valves and speaker. Carriage and insurance 10/6 extra.
A few walnut plastic cabinets to suit this receiver are available. 45/-
Send 2½d. stamp with your name and address for full details, circuit diagrams and illustrations.

LASKY'S RADIO
Lasky's (Harrow Road) Ltd.,
370 HARROW ROAD, PADDINGTON, LONDON, W.9
(Opposite Paddington Hospital) *Telephones:* CUNningham 1979 and 7214

MAIL ORDER AND DESPATCH DEPARTMENTS, 485/487 HARROW ROAD, PADDINGTON, LONDON, W.10
Telephone: LADbroke 4075

Hours: Mon. to Sat. 9.30 a.m. to 6 p.m., Thurs. half day 1 p.m. TERMS: Pro forma, Cash With Order or C.O.D. on post items only. Postage and packing on orders value £1—1/- extra; £5—2/- extra; £10—3/6 extra. Over £10 carriage free, unless specifically stated otherwise.

LASKY'S RADIO

Radio Renowned for Service & Reliability

SPEAKER FRET

Expanded metal. Finished silver.

12in. × 12in.	3/11
12in. × 18in.	5/11

Plastic. Finished bronze or cream.

12in. × 5in.	2/-
12in. × 6½in.	2/9
12in. × 16in.	6/6

SMOOTHING CHOKES

20 mA 40 H	3/11
40 mA 8 H	3/11
40 mA 10 H	4/3
100 mA 10-20 H	7/3
150 mA 3 H	3/6
250 mA 10 H	18/6

OUTPUT TRANSFORMERS

40 mA. Multi ratio	6/11
80 mA. Multi ratio	14/11
80 mA. Pentode	12/6
60 mA. Plessey, 6,000 ohms	5/11
Standard pentode	4/11
Pentode	3/6
Midget pentode	4/3
Miniature pentode. 3S4, 1S4	4/8
PX4 Intervalve	8/6
5 : 1 Intervalve	5/11

DE LUXE TELEVISION CABINETS

For 12in. cathode ray tubes. Beautiful figured medium walnut finish, with high polish. Fitted with shelf for receiver, glass speaker baffle and fret, and castors for easy movement. Undrilled. Suitable for use with the Viewmaster, "Practical Television," "Practical Wireless," and "Wireless World" televisors.

LASKY'S PRICE **£8.10.0**

Carriage 12/6 extra.

Outside dimensions of cabinet: 17½in. × 16½in. × 32in. **Why not convert your table receiver to a console?** Adaptor frames for fitting 9in. or 10in. C.R. tubes available if required.

This cabinet can also be supplied cut out for a 16" c.r. tube.

CONDENSERS

ELECTROLYTICS

32+32 mfd. 350 v.w. and 25 mfd. 25 v.w. in single aluminium can.
Latest fixing. 4/11 each.

8 mfd. 450 v.w.	2/3
8 mfd. 500 v.w.	2/11
16 mfd. 350 v.w.	2/6
16 mfd. 500 v.w.	3/6
32 mfd. 275 v.w.	2/6
50 mfd. 350 v.w.	3/11
60 mfd. 350 v.w.	3/11
250 mfd. 12 v.w.	2/-
250 mfd. 350 v.w.	4/11
8+8 mfd. 450 v.w.	4/6
8+16 mfd. 500 v.w.	5/3
12+12 mfd. 350 v.w.	3/6
16+16 mfd. 500 v.w.	4/6
16+24 mfd. 450 v.w.	5/11
32+32 mfd. 150 v.w.	2/6
32+100 mfd. 450 v.w.	7/6

BIAS

25 mfd. 25 v.w.	1/6
50 mfd. 12 v.w.	1/6
50 mfd. 50 v.w.	1/6
75 mfd. 12 v.w.	1/-

MINIATURE BIAS

10 mfd. 25 v.w., **10½d.** each, 9/- doz.

TUBULAR WAXED CARDBOARD

500 v.w. .1, .01, .02, .05, .001, .002, .005, etc., etc., **6d.** each, 5/- doz.

MINIATURE MICA

100, 200, 300, 500 PF, etc., **6d.** each, 5/- doz.

CERAMIC AND SILVER MICA

All values from **4½d.** each, 4/- doz.

MINIATURE

.1, .01, .001, .02, .002 mfd. etc., **7½d.** each, 6/- doz.

T.C.C. VISCONOL HIGH VOLTAGE CONDENSERS

(Cathodray).
.001 mfd. 12.5 kV. 7/6.
.001 mfd. 15 kV. 10/-.
.001 mfd. 25 kV. 25/-.
.1 mfd. 7 kV. 20/-.
0.4 mfd. 12.5 kV., 7/6.
Plastic case, single bolt fixing.

CRYSTAL DIODES

G.E.C. type. Glass wire ends 3/3 each. B.T.H. Type, Plastic, 3/- each.

VALVE SCREEN CANS

For button base valves. **1/3** each.
For octal valves. **1/3** each.

BULGIN SWITCHES

D.P.D.T. Change over	2/6
S.P. On/Off	1/6
S.P.D.T. On/Off	1/-

A FEW ONLY. TELEVISION SOUND AND VISION STRIPS

Birmingham frequency, T.R.F. Complete with valves. As advertised in October "Wireless World." **LASKY'S PRICE** £6/19/6, complete with valves. Carriage 3/6 extra.

E.H.T. BOOST KIT

Comprises 2 .001 mfd. 12.5 kV. Visconol condensers, 1 K3/40 S.T.C. rectifier, 1 2-meg. resistance. **PRICE** 22/6. Post free.

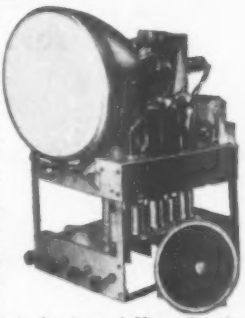
FILAMENT TRANSFORMERS

All 200-250 v. 50 c.p.s. primary.

6.3 v. 1.5 a.	7/11
6.3 v. 3 a.	12/6
6.3 v. 4 a.	14/6
2 v. 2 a.	4/11

Special Transformer. 30 volts at 2 amps., with the following tappings:—3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24 and 30 volts, 17/6.

THE VIEWMASTER



The television set you can build at home from standard parts.
Wenvoe, Kirk o'Shotts, Holme Moss, Sutton Coldfield and Alexandra Palace operation. Brilliant high definition black and white picture.
Superb reproduction.
Uses 9in. or 12in. Cathode Ray Tube. Table or Console Model.
Incorporates all the latest developments.
Television for the home constructor at its finest.
Send to-day for the CONSTRUCTION ENVELOPE, 32-page booklet crammed with top-rate information and all the necessary data, also 8 full-size working drawings and stage by stage wiring instructions. Model "A" for use in London and Home Counties. Model "B" for use in Sutton Coldfield Area. Model "C" for Holme Moss. Model "D" for Kirk o'Shotts. Model "B" for Wenvoe.

PRICE Post free **7/6** per copy.

METAL RECTIFIERS

WX3 and 6. Each	3/9
14D36	11/8
14A86	20/4
36EHT100	29/6

SUNDRIES

Morganite resistances London	36/3
All other models	35/3
Bulgin components	13/2
Colvern pot/meters, Type CLR901,	3/2 each
Type CLR4089/22,	6/4 each
Morganite type "Q" pot/meters, 5/- each	
Belling-Lee L707 and fuses	9/9

W/B & PLESSEY

Line EHT trans.	32/6
Frame trans.	25/6
3 Mc/s boost choke	5/9
Width control	10/-
Scanning coil	33/3
Main choke	15/6
Focus ring	22/6
Heater trans.: WB/103	42/-
WB/103A	52/6
Front and rear C.R.T. supports	21/6

COILS

All models available including filter chokes. Wenvoe, Kirk o'Shotts, Holme Moss, Sutton Coldfield, 28/- per set. Alexandra Palace, 20/- per set. L9 RF choke, 2/-.

CHASSIS

Sound-Vision, 18/6. Power-Pack/Time base, 18/6. Support for S.V. chassis, 6/-.

CONDENSERS

All by T.C.C.

100 mfd. CE10LE,	14/-
250 mfd. CE10DA,	10/-
2,500 mfd. 3 v.w. CE25AA	6/9

All other types in stock.

VALVES

EF50, 8/6 and 12/6 each; EBC33, 12/6; KT61, 12/10; 6P25 15/10; 6K25, 15/1; 6P28, 25/1; EB92, 10/6; EY51, 16/6.

CATHODE RAY TUBES

New and unused, fully guaranteed. All makes available from stock for immediate delivery.

9" from **£13.13.8** 12" from **£18.4.10**

Carriage and insurance extra.

Let us have your requirements.

ALL COMPONENTS IN STOCK AND SOLD SEPARATELY.

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(Opposite Paddington Hospital) *Tele*

MAIL ORDER & DESPATCH DEPARTMENT, 485/487

Hours: Mon. to Sat. 9.30 a.m. to 6 p.m., Thurs. half day 1 p.m.

Larger Screen T.V. new Wide Angle Components and Picture Tubes

CIRCUIT DETAILS AND DIAGRAMS SUPPLIED.

14in. rectangular C.R. tube	£22	8	5
17in. rectangular C.R. tube	£26	19	8
16in. round, metal cone ion trap tube	£24	6	5

Carriage and insurance extra.

ALLEN WIDE ANGLE COMPONENTS

Line and frame scan coils. Type DC300	£2	2	0
Width coil. Type GL18		10	0
Line linearity coil. Type GL16		10	0
Focus coil. Type FC302	£1	15	0
Line output and EHT transformer, 10-16 kV. Type L308	£2	10	0
Frame output transformer. Type FO305	£1	1	0
ELAC P.M. Focus magnets:			
For 14in. and 16in. tubes	£2	12	6
For 17in. tubes	£2	17	6

CONVERT YOUR VIEWMASTER TELEVISION RECEIVER TO USE THE LATEST WIDE ANGLE 14, 16 or 17-inch. CATHODE RAY TUBE.

CATHODE RAY TUBE, MASK, VALVES AND ALL OTHER NECESSARY COMPONENTS CAN BE SUPPLIED FROM STOCK FOR IMMEDIATE DELIVERY.

WRITE FOR QUOTATION.

C.R.T. MASKS. Brand new LATEST ASPECT RATIO

9in.	7/6
10in.	7/6
12in.	15/-
12in. flat face	15/-

SOILED OLD ASPECT RATIO

9in.	5/-
12in.	7/6
15in.	10/-
12in. with fitted armour plate glass (new ratio)	11/6

ARMOUR PLATE GLASS

12in. Actual size 13in. ×10¼in.	4/-
9in. Actual size 9in. ×8in.	3/-

Multi Ratio Frame Output Transformer, 10/6.

Frame Blocking Oscillator Transformer, 4/6.

Line EHT Transformer, with EY51 heater winding, 12/6.

Focus Magnet. With Vernier Control. For any type c.r. tube with 35 mm. diam. neck, 21/6.

Scanning Coils. High impedance frame, low line, 12/6. Low impedance line and frame, 14/6. Plessey. Low impedance line and frame, 25/-.

Variable Inductance Width Control, 3/6.

TELEVISION SELENIUM RECTIFIERS

The very latest "Sentercell" S.T.C. range.

K3/40, 3.2 kV	7/6
K3/45, 3.6 kV	8/2
K3/50, 4.0 kV	8/8
K3/100, 8.0 kV	14/8
K3/160, 12.8 kV	21/6

S.T.C. METAL RECTIFIERS

RM1	3/11
RM2	4/3
RM4	18/-

C.R.T. REAR END PROTECTORS

Suitable for fitting to T.V. cabinets, 2/6 each.

CLOSED FIELD LOUDSPEAKERS

Ideal for television receivers. Less o/trans. 3 ohms. Will not affect your C.R. tube.

6½in.	15/-
8in.	17/6

Introducing the

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A practical 5-channel

SUPERHET TELEVISION RECEIVER

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Complete instructions, wiring diagrams and 32-page descriptive booklet.

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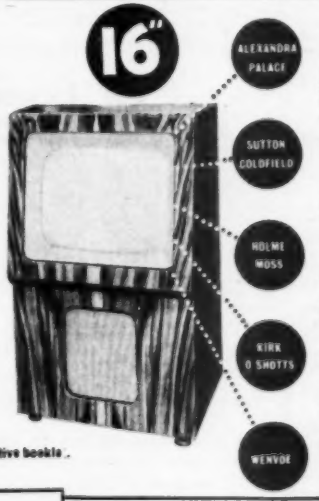

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Power pack; Sound-vision and Scan chassis. PRICE 16/- each.

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72 Resistances, all exactly as specified. 18/-.

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In maker's original sprung wood transit case.

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Oil-filled plastic 19/6. Carriage 2/6 extra.

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The tubes have either heater-cathode shorts and/or ion burns. Ideal for experimental and testing purposes. Price 12in. 55/-, 9in. 35/-.

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Primary: 200-250 v., 50 c.p.s.
Secondary: 2.5 kV., 4 mA.; 4 v., 1.1 a.; 4 v. (CT) 1.5 a.

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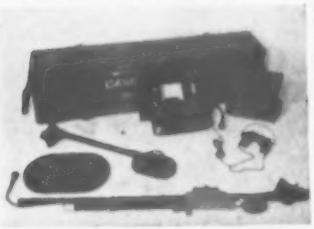
Ref. ZA14230

Of Cdn. design and construction, using 1T4 pentodes. Comprising TC. Amplifier, Search Coil, Sweep pole, Control Box, Headphones, Test Unit and Rucksack. Complete less batteries in fitted transit case.

ASK FOR No. X/H179 **£6.19.6** CARRIAGE PAID

METAL (MINE) DETECTOR NO. 3



In Original Transit Case Ref.: ZA.22755/1. Of British design and construction.
Comprises: A 3-valve AF Amplifier (ARP.12's = VP.23 Mazda), with space for dry batteries (not supplied) in metal box dim.: 10½ x 10½ x 3½in., with leads terminating in 7-way cable socket, contained in a carrying satchel, with high resistance headphones.
Search Coil, ZA.22175 or Equivalent, surface area 134 sq. ins. Dim 14½ x 10ins.
Search Coil Pole, comprising: Control Box Pole and pivot-eye assembly. Pole (rear section) and Counter-weight assy.
Small Probe. Surface area 35 sq. ins. Dim. 9 x 5½ins.
The whole contained in original fitted transit case, dim.: 52½ x 14 x 10½in. Gross Wgt. 72lb. approx.
ASK FOR No. X/H856 **£8.19.6** Each CARRIAGE PAID
Power Requirements, Dry batteries. L.T. 6 Type "S" 1½ volt cells. H.T. 60-90 volts.

BATTERY POWERED COMMUNICATIONS RECEIVER R1224A

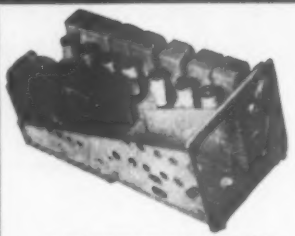
Ref. 10D/13074

Covering the **"TRAWLER BAND"**

A 5 Valve 2/VP23s, 210LF, FC2A, 220PA, 3 wavebands 10-300 metres. IF 470Kcs. SM tuned, Superhet Receiver, headphone outputs.
Complete (less batteries) in wooden cabinet with calibrated chart on hinged lid. Dim.: 14½ x 10 x 9½in., finish grey.
ASK FOR No. X/H355 **£7.19.6** Each CARRIAGE PAID
IN ORIGINAL TRANSIT CASE

R1224A RECEIVER
As above, but less valves. Used, reconditioned and tested.
ASK FOR No. X/H355A **£3.19.6** Each CARRIAGE PAID
Batteries required: H.T. 120 V., G.B. 9 V., L.T. 2 V.
Circuit of R1224A available, price 1/3.

STARTER MOTOR Type CA4750
Heavy Duty 24 Volts Starter Motor, as used in Aircraft, with recessed splined spindle and mounting by 6 Bolts. Dim.: 8½in. long, 4½in. dia.
ASK FOR No. X/H870. **21/-** Each. CARRIAGE PAID



IF AF AMPLIFIER UNIT R.1355
The popular T.V. Sound and/or Vision Unit. 5 i.f. stages, 10 valves 8 VR65s (SP61), 5U4G, VU120A, etc. etc. In metal case 18in. x 8½in. x 7½in. Used, good condition.
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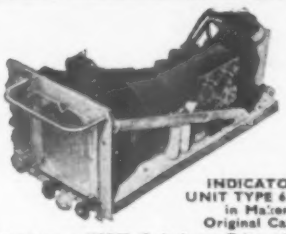
Circuit of R1355 available at 1/3.

R.F. UNIT TYPE 24
Frequencies covered 30-20 mcs. (10-15 metres). Switched tuning, 5 pre-tuned spot. freq., 3/VR65s (SP61). Output approx. 7-8 mcs. in metal case, 9½ x 7½ x 4½in.
IN ORIGINAL CARTON ASK FOR No. X/H850 **30/-** Each POST PAID
IN FAIR USED CONDITION ASK FOR No. X/H851 **19/6** Each POST PAID

R.F. UNIT TYPE 25
Frequencies covered 40-50 mcs. (6-7.5 metres). Otherwise as Type 24 above.
IN ORIGINAL CARTON ASK FOR No. X/H847 **30/-** Each POST PAID
IN FAIR USED CONDITION ASK FOR No. X/E772 **19/6** Each POST PAID

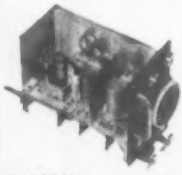


INDICATOR UNIT TYPE 6H in Maker's Original Case
Containing a VCR97 Cathode-ray Tube, with mu-metal screen, 4/VR91s (EF50), 3/VR54s (EB34), various w.w. pots, switches, H.V. conds., resistors, etc., built in metal chassis to fit into metal box 18 x 8½ x 7½in. All controls are brought to front panel beside viewing screen.
ASK FOR No. X/E777 **£4/9/6** CARRIAGE PAID

INDICATOR UNIT TYPE 62 in Maker's original case
Containing VCR97 C.R.T. with mu-metal screen. 100 K/c. Crystal unit 10XC/2, 16 VR65s, CV118 (SP61), 2 VR54s (EB34), 2 VR92s (EA50), plus pots., switches, H.V. conds. resistors, etc., built on metal chassis to fit box 18 x 8½ x 11½in. All controls brought to front panel beside viewing screen.
ASK FOR No. X/H526 **£5/9/6** CARRIAGE PAID
Also available, used, good condition.
ASK FOR No. X/E774 **79/6** CARRIAGE PAID

R3601 Receiver Unit.
ASK FOR No. X/H493 **£4/12/6** CARRIAGE PAID

For Inexpensive Television



R.F. UNIT TYPE 26
Frequencies covered 65-50 mcs. (5-6 metres). Variable tuning 2/VR136s (EF54), VR137 (EC52). Output approx. 7-8mcs. in metal case 9½ x 7½ x 4½in. Uncartoned but good condition.
ASK FOR No. X/H848 **67/6** Each POST PAID

R.F. UNIT TYPE 27
Frequencies covered 85-65 mcs. (3.5-5 metres). Otherwise as Type 26 above.
ASK FOR No. X/E771 **63/-** Each POST PAID
CIRCUIT AVAILABLE AT 1/3, POST PAID.

INDICATOR UNIT TYPE 62A
Containing VCR 97CRT with mu-metal screen. 12-VR91s (EF50), 4-VR65s (CV118-SP61), 3-VR92s (EA50), 2-VR54s (EB34) Plus pots., switches, H.V. cond. resistors, etc., etc. Built on metal chassis to fit box size 18 x 8½ x 11½in. All controls brought to front panel beside viewing screen. Appearance as (H526/E774) Type 62. Used, Good Condition.
ASK FOR No. X/H868 **£7/19/6** CARRIAGE PAID

R3170A Receiver Unit.
ASK FOR No. X/H492 **£4/12/6** CARRIAGE PAID

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Article by B. L. Morley using Indicator Type 62 ..... 1/6.
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E.H.T. 55/-, 57/6, 59/6 or 65/- each. Mains (Morley) 55/-, 60/-, (Argus) 69/6 each
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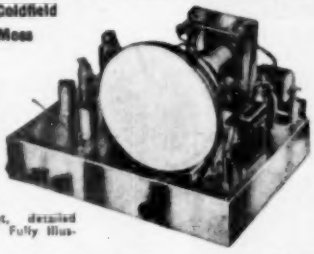

Contains complete Assembly Instructions, circuits, 8 full size wiring diagrams, can be used as templates. Stage by stage layout, detailed parts list, etc., etc. Fully illustrated.

Designed in association with foremost manufacturers. Parts made by Bulgin, Whiteley, Ediswan, T C C., Westinghouse, G.E.C., Colvern, Belling & Lee.
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With f/4-5in. lens.
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In fitted transit case. Carriage Paid

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50 watt Amplifier
£60

High gain, single unit with 7 valves EF40, 2 ECC40s, 2 53KUs, 2 KT66s and S130 Neon. 4 Microphone Inputs, separate bass and treble controls, built-in Meter, and many other features. Input imp. mic. 15 ohms, gram. 500,000 ohms. Gain Mic. 117DB, gram. 70DB.
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A.C./D.C. mains 200/260 V. 12 watts output, complete with two Loudspeakers, Microphone, stand and leads.

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Also **LOUDSPEAKERS OF ALL TYPES.**
Line matching Transformers, Plugs, Cable, etc., etc.

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MODEL 680X **£105.0.0**
Continuous coverage 30 mcs.—480 Kcs. in 5 Ranges. Fifteen Valves. Two IF Stages. Variable Selectivity. "S" Meter. Two RF Stages. Separate Oscillator. Crystal Filter. Push-Pull Output. Polychromatic Finish.
Reliable Reception in any part of the World.

MODEL 740 **£38.15.0**
1.4-30.6 mcs. and 205-620 Metres in 4 Ranges.

Eight Valves. "S" Meter. BFO. Delayed AGC System. Separate Gain Controls. Noise Limiter. Black Ripple Finish.

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10-51.7 metres and 110-575 metres in 4 ranges. The Marine Receiver. AC/DC 110/250 V. Seven Valves. Metal Rectifier. Fine Tuning Indicator.

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80-620 Metres and 900-2,300 metres in 3 Ranges. Yachtsman's Receiver. 12 Volt Operation. Receives Consol Navigation System. Time Signals, 600 Metre International distress wave, Trawler and small Shipband.

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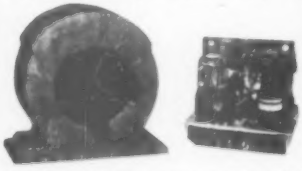
A Midget 4-valve Superhet Portable Set covering medium and long wavebands.
Designed to operate on A.C. mains 200/240 volts, or by an "All-dry" battery. The set is so designed that the mains section is supplied as a separate unit which may be added at any time. The Kit therefore can be supplied (as an "All-dry" Battery Superhet Personal Set which can then be accommodated in the Attache Case as illustrated above (size 9½in. × 4½in. × 10in.). This is attractively finished in fawn morocco, dark green or blue rexine (to or as a Combined Mains/Battery Superhet Portable Receiver, for which a polished Wood Cabinet is available to accommodate both Mains Unit and Battery together.
Circuit incorporates delayed A.V.C. and Pre-selective Audio Feedback. Kit is complete in every detail and includes ready wound Frame Aerials, fully aligned I.F. Transfs., and drilled Chassis, etc. Overall size of assembled chassis 8in. × 6in. × 2½in.
This Receiver, as illustrated, can be completely built for approx. £10 (plus Mains Unit if required). Send 1/9 for the fully descriptive Assembly Book which includes Practical Layouts and complete price list of Components.

THE "MINI-TWIN" 1-VALVE BATTERY SET

A design of a simple 1-valve 2-Stage Battery Receiver, giving excellent results on Medium and Long Wavebands and having exceptionally low Battery consumption.



Drilled Chassis and Practical Diagrams make it the ideal set for the beginner to build.
The complete chassis including valve can be built for 37/6 the attractive Plastic Case is 9/6, and suitable headphones 14/9.
The complete Assembly Instructions, Layout and Component Price List are available for 1/6.
This Receiver also performs excellently without modification, as a Tuning Unit, and in addition, with simple modifications for which a complete diagram is provided makes a first-class Pre-amplifier (for Pick-Up or Microphone).

STERN'S "RADIO TUNER MANUAL." Price 2/6 (Plus 3d. post). Contains complete and detailed Assembly Instructions showing how to make:—
A 1-valve T.R.F. Tuning Unit, covering long and medium wavebands.
A 2-station "Pre-set" Superhet Tuning Unit, producing 2 stations on medium waveband and 1 on long wave.
3-Valve Superhet Tuning Unit, covering short, medium and long wavebands.
Each Tuner is for A.C. mains operation. Circuit Diagrams and Practical Component Layouts are shown, together with Complete Component Price Lists.

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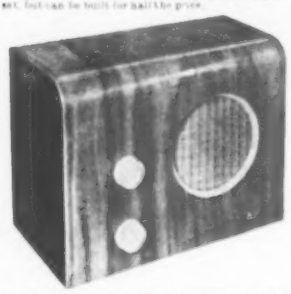
Collaro "G.P.20." for standard records £3/11/5; stereohan cable (1 P.U) Head for L.P. records £2/3/4
Decca lightweight turnover Head type, for L.P. and standard records £3/19/2.
Marconi, Standard, lightweight Magnetic £1/15/10
Marconi Matching Transformer, 7/6.
Goldring, Standard lightweight Model at 35/10.

A MIDGET 4-STATION "PRE-SET" RECEIVER

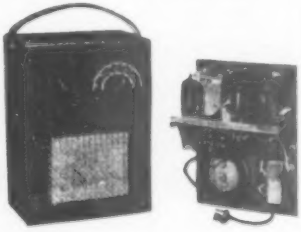
A complete Kit to build a 4-station "Pre-set" Superhet Receiver for A.C. mains operation.
The Set is designed to receive any three Stations on medium waveband and one on long wave, each Station being received by the turn of a Rotary switch—No Tuning being necessary.
It is of midget size, being 8½in. × 4½in. × 7½in. high, and has the performance of a far more expensive ready-made set, but can be built for half the price.



Price of complete Kit of Parts (including aligned I.F. Transf. and drilled Chassis, etc.), £9/15/- (Incl. P.T.) (plus Cabinet 25/6), or the components can be purchased separately. The complete Assembly Instructions, including Individual Component Price List, Circuit and Component Layout, etc., are available for 1/9.

THE "MINI TWO-THREE" BATTERY PORTABLE

An "All-dry" Battery Portable of midget size, (6¾in. × 4¾in. × 3¾in., designed to cover medium waveband 190-550 Metres, with use of short trailer Aerial.



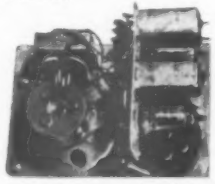
The simple design of this Receiver is so arranged that either a 3-valve Set or a 2-valve (afterwards easily converted to the 3-valve) can be made.
Consists of a T.R.F. circuit, using a Regenerative Detector with H.F. Stage, and a High Gain Output Pentode. Valve line up 1T4—1T4—DL94.
The 2-valve Set can be completely built for £4/3/6 (less Case), and the 3-valve for £5/3/- (less Case). Each price includes Valves, Speaker and drilled Chassis.
Send 1/9 for the Assembly Instructions, they include simple and complete Practical Component Layouts and Diagrams which enable the most inexperienced constructor to successfully build either Set. All Components are available for separate sale, a price list being supplied with the Assembly Instructions.

THE "WIRELESS WORLD" 3-VALVE SET

A Midget 3-valve T.R.F. Receiver for operation on A.C. mains, covering long and medium wavebands.
We are able to supply all of the components to build this set, as designed and specified in the Feb. 1950, issue, including the drilled Chassis. Valves and moving coil Speaker etc., at the following prices:—
To construct complete Chassis, less Dial and Drive Assembly £5/5/-. Ditto, including Dial and Drive Assembly, £6
To construct the compete Set, including Dial and Drive Assembly and Cabinet, £7/3/6.
Overall size of Cabinet is 7¾in. × 5¼in. × 11¼in
A reprint of the designer's article, giving Circuit and Assembly Instructions (this is available separately for 9d.) together with a Practical Component Layout is included with each of above assemblies.

THE "PRACTICAL WIRELESS" "MINI FOUR" BATTERY PORTABLE

A 4-valve Battery/Superhet Receiver designed to receive 4 Pre-set Stations, three on medium waveband and one on long wave to suit local conditions. Each Station is obtained on the set by the turn of a Rotary Switch. No tuning is necessary.



It is of midget size, being only 6¾in. × 5¾in. × 4¾in. when completely built, and is very easily assembled from diagrams supplied.
Cost of all components to build this Set, in accordance with the design, including a drilled and cut chassis and panel, and new valves, is £9/10/- (or less valves for £6/7/6). Attractive carrying case finished in blue leatherette, 16/9. Complete constructional data with a blue print, which shows the Practical Component Layout and Wiring Diagram, together with an Individual Component Price List is available separately, 1/6.
Our Battery Eliminators (illustrated opposite) available in kit form are suitable for use with this set.

THE "WIRELESS WORLD" MIDGET A.C. MAINS 2-VALVE RECEIVER

We can supply all the components to build this set, including Valves and Moving Coil Speaker for £3/10/-, including designers' Complete Building Instructions (these are available separately for 9d.)

★ *Send 9d. P.O. for our STOCK LIST, it shows "hundreds" of Wireless*

When ordering please include

STERN RADIO LTD., 109

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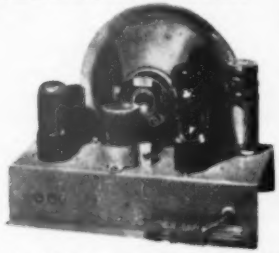
A Complete Kit of Parts to build a 3-4 WATT HIGH GAIN AMPLIFIER

for operation on A.C. or D.C. Mains, 200-250 volts.



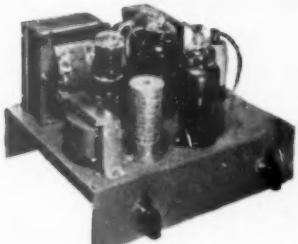
This amplifier will give 3 Watts output for the small input voltage of only 78 millivolts, and is therefore suitable for use with any type of pick-up from the crystal type to the miniature H.F Magnetic type.

A tone control is incorporated and the quality produced is excellent. The overall size of chassis is 9in. × 5in. × 7½in., and valve line up 25Y5-6SH7-25L6.

Price of complete kit including drilled chassis and Valves **£4 2 9**, plus 9/6d. P.M. (which fits on chassis), **16/-**, or 5in. P.M. **18/9**.

Copy of Assembly Instructions and Components Price List available for **1/3**.

A QUALITY "PUSH-PULL" AMPLIFIER KIT



A Kit of Parts to build a 6-8 watt Push-Pull Amplifier for operation on A.C. mains 200-250 volts.

Incorporates a simple arrangement to enable either a magnetic, crystal, or lightweight pick-up to be used.

A 10-watt Output Transformer is designed to match from 2 to 15 ohm speakers. Tone control is incorporated.

The overall size of the assembled Chassis is 10in. × 6in. × 7½in. high. Price of Kit, complete in every detail, including drilled Chassis, and Valves, **£6 13 6**. Component Layout is supplied.

Price of assembled Chassis, supplied ready for use, **£8 2 6**.

"PERSONAL SET" BATTERY ELIMINATOR

A complete Kit of parts to build Midget "All-dry" Battery Eliminator, giving approx. 90 volts and 1.4 volts.

This eliminator is for use on A.C. mains and is suitable for any 4-valve Superhet Receiver requiring **H.T. and L.T.** voltage as above, or approx. to 60 volts.

The Kit is quite easily and quickly assembled and is house in a light aluminium case size 4½in. × 4½in. × 3½in. Price of complete Kit with easy-to-follow Assembly Instructions, **42/6**.

In addition we can offer a similar COMPLETE KIT to provide approx. 90 volts and 1.4 volts. Size of assembled Unit 7in. × 3½in. × 4½in. Price **47/6**.

You're SURE to get it at

STERN'S

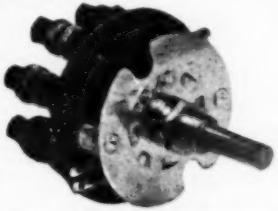
ESTABLISHED 25 YEARS

TWO NEW DENCO ULTRA MIDGET SUPERHET COIL TURRETS

Both having a Rotary Turret Action

(a) The C.T.9 Turret consists of 4-STATION "PRE-SET" UNIT from which any three Stations on medium waveband and one on long wave can be received by a turn of the Turret Switch.

(b) The C.T.10 Turret being a 3-wave and Coil Pack. Incorporating a fourth switch position providing for completely switching out Radio when using Gram. The complete coverage is: long waveband 700 to 2,000 metres; medium waves 190 to 570 Metres and short waves 13 to 50 Metres.



The outstanding advantages these units have over other similar units can be readily seen, the main features being:

(a) Neat and compact, the overall size being only 2¼in. dia. × 1¾in. deep.

(b) Fitting is simplicity itself, each Turret having one-hole fixing and requiring only four connections.

(c) The Rotary Turret design switches the actual Coils, which incorporate variable iron dust cores, onto positive contacts, thereby reducing stray capacitors to the absolute minimum.

(d) They are supplied Factory wired and aligned and have been designed to operate with any conventional circuit arrangement of 465 kcs. and due to their unique design are extremely sensitive and efficient.

Price C.T.9 Turret, **42/10**. C.T.10 Turret, **58/-**.

A complete Receiver Circuit together with leaflet containing all necessary data is included with each Turret. These can be supplied separately for **6d.**

BATTERY CHARGER KITS

All Kits incorporate Metal Rectifiers, and are for use on A.C. mains 220-250 volts. All Kits include an easily followed Wiring Diagram.

For charging 2- 4- or 6-v. batteries at 1 amp., **£1 8/-**.

For charging 6-volt battery at 1 amp. with Variable Resistor and Meter, **£2 12 6**.

For charging 12-volt battery at 1 amp., **£1 9 3**.

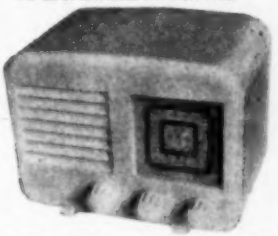
For charging 12-volt battery at 1 amp., with variable Resistor and Meter, **£2 14/-**.

For charging 6- or 12-volt battery at 2½ amps., **£2 1/-**.

For charging 6- or 12-volt battery at 2½ amps., with Variable Resistor and Meter **£3 8 3**.

A 5-VALVE "ALL-WAVE" SUPERHET RECEIVER

For use on A.C. Mains 200 to 250 volts.



This small attractive Receiver, embodying modern circuit technique is designed to cover Short, Medium and Long wavebands, and incorporates the following outstanding features:

- A superhet circuit designed for high efficiency on all three wavebands
- A 3½in. P.M. Speaker accurately matched for good quality reproduction.
- The latest range of new 8-volt B.V.A. miniature valves.
- Built-in Frame Aerial with provision for external aerial for distant stations.
- A White Plastic Cabinet of very attractive appearance overall size 7½in. × 5½in. × 5½in.
- THE RECEIVER AS ILLUSTRATED CAN BE BUILT FOR APPROX. **£10 10/-**.

Send 2/6 for the fully descriptive stage by stage assembly and wiring diagrams, with which complete price details are given.

THE FAMOUS W.B. "STENTORIAN" RANGE OF P.M. SPEAKERS.

Size.	Impedance.	Watts	Price
2½in.	2-3 ohms	1	18 6
3½in.	"	2	19 6
5in.	"	2½	21/-
6in.	"	3	24 6
8in.	5 (also in 15 ohms)	5	32 6
9in.	"	7	36 9
10in.	"	10 (also in 15 ohms)	44 6
12in.	15 ohms	15	£9

Tele-vision—Complete range of **Haynes** Components are in stock. Enquiries welcomed.

The Viewmaster Televisor.—We have had very considerable experience in assisting customers to build this T/A and can supply all SPECIFIED COMPONENTS EX STOCK. The Assembly Instructions showing Practical Layouts and Price List are available for **7/6** for London, Sutton Coldfield, Holme Moss, Kirk-o'-Shotts and Wenvoe.

Denco "F" Liner, for accurately tuning 465 Kcs and 1.6 Mcs I.F. channels, and associated circuits. Battery operated small and completely self-contained. **59/6** plus **2/2** for battery.

THE FAMOUS "SHAFTESBURY" RIBBON MIKE. Incorporating internal line Transformer having Transformation ratio 1 ohm ribbon impedance up to 500-600 ohms. Reduced from £10/10/- to **£6**.

A spare ribbon to grid, 500/600 ohm. Transformer is also available for **25/-**.

Transformers. (a) Input 230 volt, output 200 volt 25 mA and 6.3 v. 2 amp., **11/9**; (b) Input 230 volts, output 250 volts 30 mA. and 6.3 volts 1 amp., **14/6**.

E.H.T. Transformer. Prim. 220 v. Sec. 5 Kv. and 4 volt tapped 2 volt, **59/9**. Do., but 4 Kv., **57/6**.

Metal Chassis, substantially made with four sides, 7in. × 4in. × 2in., **3/11**; 9 × 5 × 2½in., **5/3**; 10 × 6 × 2½in., **6/-**; 10 × 7 × 2½in., **6/3**; 12 × 9 × 2½in., **7/9**; 14 × 9 × 2½in., **8/3**; 16 × 8 × 2½in., **9/-**. All sizes also available in aluminium at **6d.** extra.

New Mitr. Surplus Transformers. Input 200 to 240 volts, output 12 v. 6 amps., **21/-**.

H.T. Rectifiers.

Types.			
14DE36,	11/3 ;	14HT29,	12/6 ;
14HT36,	17/9 ;	26HT5.5,	13/10 ;
26HT30,	16/2 ;	36HT40,	20/6 ;
36HT45,	22/6 ;	36HT50,	24/10 ;
36HT80,	35/6 ;	36HT100,	29/5 ;
36GHT15,	7/9.		

F.Wave Bridge Rectifiers:

For charging 2, 4 or 6 volts at 1½ amps.	13/-
For charging 6 or 12 volts at 1½ amps.	15/6
For charging 6 or 12 volts at 3 amps.	21/6
For charging 6 or 12 volts at 5 amps.	29/10
For charging 12 or 24 volts at 3 amps.	25/9

Meter Rectifiers. Westinghouse 250 micro-amp., **12/9**; 1 mA. **11/9**; 5 mA. **6/6**.

Selenium Rectifiers. H.T./H. wave, 250 v. 50 mA. **6/6**; 250 v. 100 mA. **8/6**; 250 v. 120 mA. **15/6**.

Charger Transformers. A.C. ratings. Suitable for use with preceding rectifiers. Each has input of 230 volts.

Outputs: (a) 24 volts tapped 18 v. 9 v. and 4 v. at 3 amps., **26/6**; (b) 30 volts tapped 15 v. and 9 v. at 3 amps., **26/9**; (c) 15 volts tapped 9 v. at 3 amps., **21/-**; (d) 12 volts 1½ amps. **12/3**; (e) 15 volts tapped 9 v. at 6 amps., **25/6**; 15 volts tapped 9 v. at 1½ amps., **15/9**; 12 volts 1 amp., **7/6**.

A Battery Charger Wiring Diagram is included with purchase of Charger Transformer and Rectifier.

Components and many KITS OF PARTS for both Sets and Battery Chargers approx. costs of Post and Packing.

& 115 FLEET STREET, E.C.4

5814 and 2280

GARLAND

ANNOUNCING

THE TRUVOX TAPE DECK
AND AN AMPLIFIER WORTHY OF IT

TRUVOX TAPE DECK

- By the world-renowned Rola-Celestion-Truvox organisation.
- Two speeds—3¾in. and 7½in. per second.
- Half-track high impedance heads, record-playback head wound on mumetal laminations, and erase head wound on radiometal laminations.
- Two hours playing time available with one 1,200ft. reel of tape.
- Electronic H.F. erase.
- Fast forward-wind and re-wind without tape handling.
- All controls operated by one row of automatic push-buttons.
- Automatic instantaneous braking.
- Three motors designed for constant duty and noise-free operation—NOT gramophone motors.
- Precision construction reduces wow and flutter to utterly negligible proportions.
- Lightweight Formica laminated panel reduces total deck weight to 14lb.
- Width 16½in. Depth 13in. Thickness of panel ⅜in. Max. height above panel 1½in. Max. projection below panel 4½in.

PRICE 22 guineas (C).

AMPLIFIER RP8—Provisional specification

- Built on two cable-connected chassis to minimise interaction.
- Low noise, low microphony first stage.
- Push-pull output, providing 6 watts high fidelity reproduction over a wide frequency range and at very low distortion, to 3 ohms or 15 ohms.
- Frequency-selective negative feedback loop.
- High and low gain inputs for all types of microphones, pick-ups or radio.
- Straight-through facility for direct operation as microphone or gramophone amplifier.
- Power supplies and oscillator unit incorporated.
- Magic eye recording level indicator, and provision for phone monitoring.
- Standard valves—6BR7, 6SH7, 6U5G in pre-amp and control unit; 6SH7, KT61, KT61, KT63, 5Z4G in main amplifier.
- 8in. p.m. loudspeaker included, and changeover switch for use with external loudspeaker.
- Engraved control panel on pre-amp.
- Pre-amp chassis: 12in. x 5in. x 6in., with control panel 13in. x 3in.
- Main amplifier chassis: 12in. x 5in. x 7in.

PRICE 19 guineas (C).

Suitable portable, table and console cabinets shortly available.

If deck and amplifier ordered together, a 1200ft. reel of Scotch Boy tape and a spare spool are supplied, at no extra charge.

AMPLIFIER ACII (C) Incorporates volume and tone controls, providing 4 watts output. The chassis is completely isolated from the mains. Amplifier wired and tested, **£6/2/6**, plus 5/- carriage. ***GARLAND KIT** for ACII **£5/2/6**, plus 5/- carriage.

GARLAND ACIV AMPLIFIER (C) Providing exceptionally wide frequency response and low harmonic distortion at a maximum output of 11.5 watts. High and low gain inputs with bass, treble and volume controls. Standard valves throughout. **18 gns.** plus 15/- carriage, etc.
***GARLAND KIT** for ACIV **£13** plus 15/- carriage, etc.

MICROPHONES Ronette B110 Crystal microphone **£3/12/6**. Ronette HM7 Filtercell Microphone **£3/7/6**. The following stands are suitable for the above microphones. Floor stand **£4/10/0**. Table Stand, **£2/12/6**. Desk Stand, 15/6.

LANE TAPE TABLE (C) Three motors; very fast wind-on and re-wind; automatic braking; high impedance, half gap heads; tape speed 7½in. per sec. **£16/10/0**, plus 10/- carr. *(Trade Supplied).*

HIGH QUALITY AMPLIFIERS (C) LEAK "Point One" TL12/12 watt, **27 guineas**. LEAK RC/PA/U remote control pre-amplifier, **9 guineas**. LEAK "Vari-slope" pre-amplifier, **12 guineas**. ACOUSTICAL QUAD 12-watt Amplifier (including pre-amplifier), **£35**. ROGERS "WILLIAMSON" AMPLIFIER, **£31**. "WILLIAMSON" PA/TC/UNIT, **£10/7/6**. ROGERS "RD BABY DE LUXE" including pre amplifier, **£18**. ROGERS "JUNIOR DE LUXE" 10 watt, **£26/10/-**. ROGERS "MINOR" 4 watt, **£11**★

B.S.R. MONARCH AUTO-CHANGER (C) Designed to play 10, 7in., 10in. or 12in. records intermixed at 33⅓, 45 and 78 r.p.m. The reversible pick-up is self compensated for the L.P. characteristics. For operation on 100/125/200/250 volts, 50 cycles A.C. Price **£17/17/-**.

SCOTCH BOY HIGH COERCIVITY TAPE. We recommend this tape for use with the GARLAND Tape Recorder Now available in the following lengths. 1,200ft. **35/-**; 600ft. **21/-**; 300ft. **12/3**. Spare 7in. spools (1,200ft.) **4/3**.

DE LUXE TAPE RECORDER CABINETS (C) Veneered walnut, to take UE7 Amplifier and Lane Tape Table **£6**.

GARLAND UE.7 RECORD PLAYBACK AMPLIFIER (C) This Amplifier is specially designed for the Lane Tape Table but is suitable for use with any high impedance head. Incorporates all Garland star features. Five standard valves are used providing supersonic bias and erase and equalise record and playback facilities. Complete with 8in. loudspeaker. Amplifier wired and tested **12 guineas**, plus 7/6 carriage, etc. *Trade supplied.* **GARLAND KIT** for this Amplifier **£9/15/-**, plus 7/6 carriage, etc.

GARLAND TAPE RECORDER (C) Includes a 1,200ft. reel of "Scotch Boy" Tape, and a spare spool. For direct record and playback from radio, mike or pick-up. Incorporating the Lane Tape Table and the UE.7 Amplifier in a walnut veneered cabinet. Price **£37/10/-**, plus 15/- carriage, etc. *Trade supplied.* **GARLAND KIT** for this Recorder **£32/5/-**, plus 15/- carriage, etc.

"VIEWMASTER" and "ELECTRONIC ENGINEERING" TELEVISORS All components in stock as previously advertised.

BROS, Ltd.

I.F. TRANSFORMERS. Small size, 2¼in. x 1¼in. x 1in., 13/6 per pair. Made for us by a leading manufacturer.

UNDRILLED CHASSIS. In 20 s.w.g., bright mild steel : Four-sided size 13in. x 7in. x 2½in., 7/6 each ; two-sided with two straps, size 12in. x 4in x 2½in., price 3/9 each. Two sided with two straps, size 6 x 5 x 2in., price 2/6 each.

OSMOR Q COILS. Wound on 1in. high Polystyrene formers with variable dust iron cores. Available in the following ranges : Mains superhet, aerial, H.F. and oscillator, 13-35, 15-50, 35-120, 70-330, 190-520, 800-2,000, metres. Mains or Battery Superhets : 18-50, 190-560, 800-2,000 metres. Mains or Battery TRF, aerial and H.F. : 190-560, 800-2,000 metres. Portable Superhet, Battery or Mains : aerial coil 190-560 metres and long wave aerial loading coil 800-2,000 metres. All the above coils at 4/- each Medium wave spiral wound frame aerial (5½ x 3½in.) for portable superhets, battery or mains, 2/6.

OSMOR COIL PACKS. Type H.O. mains superhet 15-50, 190-520, 800-2,000 metres, 52/-. Type TRF medium and long waves incorporating a reaction winding, 43/4. Type B for mains or battery portable receivers using a frame aerial and covering 15-50, 190-560, 800-2,000 metres 54/2. All the above prices include purchase tax. Note : Included with each coil pack are complete circuits and layout diagrams.

WEARITE 705 COIL PACK. For mains superhets covering long, medium and short waves. An additional position is provided on the switch for gramophone. Price including purchase tax £2.13/4.

REACTION CONDENSERS. Solid dielectric, also suitable as tuning controls in one-valve receivers. Available in 300 pf and 500pf sizes with standard ¼in. spindle. Price 3/10.

AMPLION CONVETTES. These units enable a battery receiver to be operated from the A.C. mains. Model AD2 supplying 90 volts H.T. at 10 mA 1.4 volts L.T. at 250 mA., price £4/19/6. Model VA1, 120 volt at 10 mA., and 2 volt at 0.8 amp., price £4/19/6. Model M2V 100-140 volt at 10-20 mA., and 2 volt 1 amp. This unit also incorporates an L.T. voltmeter. Price £6/16/6.

AMPLION ACTIVETTES. Dry batteries can be reactivated by connecting them to these units after use. They pay for themselves in a few months. Model R.B. for standard dry batteries, £3/5/-. Model H.B. for hearing aid type batteries, £4/4/-.

CERAMIC SWITCHES. Single pole, eight-way, 3/6 each.

J.B. SQUAREPLANE DIALS. Printed in two wavebands with station names. 8/1 drive and bronze escutcheon and glass. Price 12/9.

J.B. FULL VISION DIALS. Similar to above but with 7½ x 3½in. dial printed in three wavebands. Price 13/-.

METAL CUTTING SHEARS. A robust tool with one-inch blades, will cut up to 16 s.w.g. aluminium. Per pair, 2/- ; per doz. pair, 21/-.

CARBON RESISTORS

ONE-THIRD TO ONE-HALF WATT : 10, 13, 15, 22, 33, 39, 56, 68, 71, 73, 100, 150, 170, 180, 220, 250, 270, 330, 390, 400, 450, 470 500 530, 600, 680, 820, 1k, 1.2k, 1.5k, 2.2k, 3.3k, 3.9k 4k, 4.7k, 5.6k, 6.2k, 6.8k, 7.5k, 8.2k, 10k, 12k, 15k, 18k, 20k, 22k, 24k, 25k, 27k, 30k, 33k, 39k, 40k, 47k, 50k, 56k, 100k, 150k, 220k, 270k, 330k, 470k, 680k, 1m, 1.2m, 1.5m, 2m, 2.2m, 2.7m, 3.3m, 4.7m, 10m. All at 4d. each.

ONE WATT : 50, 56, 82, 120, 150, 240, 330, 390, 680, 1k, 1.5k, 2.2k, 3k, 3.9k, 4.7k, 5.1k, 5.6k, 6.8k, 10k, 12k, 18k, 22k, 24k, 27k, 33k, 68k, 70k, 80k, 170k, 330k, 390k, 470k, 680k, 750k, 1m, 2.2m, All at 6d. each

TWO WATT : 220, 1k, 2k, 2.2k, 3k, 3.3k, 4.3k, 4.7k, 6k, 10k, 12k, 20k, 22k, 27k, 30k, 47k, 50k, 68k, 2.2m. All at 9d.

FOUR WATT : 500k, 1/- each.

JONES PLUGS AND SOCKETS : Fitted with robust flat pins to handle substantial currents. Metal housing (screen) and cable entry on female socket is supplied, but can be changed over to male plug if required. Six-way plug and socket complete, 1/9. Eight-way ditto, 2/-. Ten-way ditto, 2/6.

PYE PLUGS AND SOCKETS : The ideal temporary or permanent connection for coaxial, or other screened cable to chassis. For ¼in., ⅜in., or ½in. cable. Plug and socket complete, 1/3 each, 12/- per doz., £6 per gross.

LOUDSPEAKERS at PRE-TAX PRICES. By leading manufacturers. Brand new and fully guaranteed. 5" p.m. moving coil 12/6. 5" mains energised, with output transformer, 19/6 8" p.m. moving coil, 17/6.

METAL RECTIFIERS

Type RM2, 125 v. at 100 mA. Two in series required for mains voltage. Price 4/6 each. Type 14D/972, providing 250 v. 25 mA. when used with a reservoir condenser. Small size ideal for test equipment also in place of 14D/36 in T.V circuits. Price 6/6 each. 6 v. 1 a. half-wave (or full wave with C.T. trnsr.), price 5/- each ; 12 v. 1 a bridge, price 8/6 each ; 12 v. 4 a. bridge, price 22/6.

SENSITIVE NEONS : 85 v. striking. SBC with centre contact. Ideal for record level indicator on tape recorders, mains indicator, etc., 2/6 each.

HIGH VOLTAGE MICA CONDENSERS 0.1μF 1,500 v. wkg. Bakelite-cased upright mtg., 3in. x 2¼in. x 1¼in. overall, 2/- each. Ceramic pot type, 10C/2178, 0.0002μF 5 kv wkg., high H.F. current, 2/6 each. Flat bakelite-cased type, ZA2837, 0.001μF, 5 kv. A.C. test, 0.5 A. at 2-8 mc. ; size 3¼in. x 1¼in. x ⅝in. ; suitable tx or tv, 1/9 each. 0.002μF, 2.5 kv. wkg., 1/3.

TOROIDAL CERAMIC POTENTIOMETERS. 17k, 100 watt, 8/6 ; 2.4k, 50 watt, 6/6

TOGGLE SWITCHES. SPCO, 250 v. 2 amp., 1/9 ; DP on-off 250 volt, 1 amp., 2/3

ENGRAVING TOOL. Operates from 200-240 volt A.C. for engraving on metal and plastic, price, 12/6.

WAFER SWITCHES

For ¼in. dia. spindle. Length of spindle quoted from end of bush.

3p. 2w. ⅜in. 1/9.
6w. paralelling ⅜in., 1/9.
1p. 3w miniature ⅜in., 1/3.
4p. 2w. miniature ⅜in., 1/9.
1p. 10w., ⅜in., 1/9.
1p. 11w, ⅜in., 2/-
3p. 3w. miniature 7/16in., 1/9.
4p. 3w. miniature 2½in., 3/6.
4p. 3w. ⅜in., 1/9.
4p. 2w 4 bank ⅜in., 3/6
3p. 3w. 3 bank ⅜in., 3/-

FIXED CONDENSERS : (pF's) : Ceramic : 2, 4, 15, 20, 27, 30, 50, 220, 350. All at 9d. 1,000pF 1/-. Silver Mica : 10, 30, 50, 160, 170, 180. All at 6d. 200, 300, 1,500, 2,100, 9d. Moulded Mica : 50, 75, 100, all at 6d. 300, 470, 1,000, 2,000, 3,000, 4,000, 4,500, 4,700, 5,000, 10,000, all at 9d.

CLOSE TOLERANCE SILVER MICA CONDENSERS. All plus or minus 1 per cent. 100pF, 400pF, 9d. each. 1,000pF, 1,400pF, 1/3 each 10,000pF, 1/6 each.

SPECIAL TYPE VALVE OFFER. CV1141 (NGT1), 4 v. THYRATRON. Electronic relay for timers, etc. B5 base, 6/6 each. CV265 4 v. ½-wave high current rectifier. IL base, 5/- each. 7193 6.3 v. UHF triode. Plug-in replacement for 6J5G if anode and grid top caps connected to pins 3 and 5. IL base, 2/6 each. 6SH7 6.3 v. HF pentode. For T.V. amplifiers, receivers, etc. IL base, 6/6 each. RL18 6.3 v. miniature triode B3G base, 5/- each. 6U5G 6.3 v. magic eye. Ideal for bridges, recorders, etc. IL base 7/6 each. U22 2 v. EHT rectifier for T.V. MO base, 8/6 each.

MULTI-PURPOSE TOOL. Bends, shears, punches and threads sheet-strip and rod For all the little workshop jobs that waste your time. Tool price, 10-. Jig, gauge and protractor for use with this tool, enabling repetition work to be carried out with precision, 7/6.

PULLIN MOTORS. Type A/3R, for operation from 24 volt D.C. 3¼in. x 2⅜in. x 3in. Price, 8/6 each.

AERIAL RODS. These 12in. long tubes are once again available, made of copper plated steel. Fit into each other to make up any length aerial. Price per doz., 2/6 ; per gross 21/-.

TAPE RECORDER OSCILLATOR COILS. Inductance 6.3 mH, giving frequency of 45 Kc/s with a .002 mfd. condenser. For use with high impedance heads. Made for us by a leading manufacturer. Price 6/9 each. *Trade supplied.*

SUPERHET PACK. Consisting of a walnut Pabinet, size 19in x 15in. x 8in , complete with Perspex dial ; undrilled chassis size 13in. x 7in. x 3in ; 8in. Elac speaker ; 500pF twin-gang tuning condenser ; 250-0-250 v., 6.3 v. and 5 v., mains transformer ; L.F. choke ; output transformer ; 16-24 mfd. 350 v. electrolytic condenser. These items are not surplus, but current production goods. Price £4/15-, including packing and carriage (G B. only). (C)

CLEAREX TELEVISION MAGNIFYING LENS. 9in. clear, 55/- ; 9in. filter, 60/- ; 12in. clear, 75/- ; 12in. filter, 80/-. Carriage and packing 5/- each on all types. (C)

ALL GOODS NEW AND UNUSED. **ITEMS (C) REQUIRE CRATING FOR SAFE DESPATCH. CRATES ARE NOT CHARGED PROVIDED YOU UNDERTAKE TO RETURN CARRIAGE PAID TO US.**

PLEASE ADD POST OR CARRIAGE ON ALL ITEMS. KINDLY PRINT NAME AND ADDRESS. POST ORDERS TO OUR DEPTFORD ADDRESS. EARLY CLOSING THURSDAY. OPEN ALL DAY SATURDAY

GARLAND BROS, Ltd.

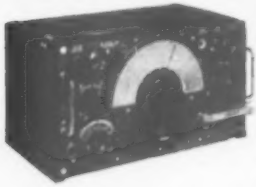
CHESHAM HOUSE, DEPTFORD BROADWAY, S.E.8

Telephone: TIDEWAY 4412/3

5 OBELISK PARADE, LEWISHAM, S.E.13

Telephone: LEE GREEN 4038

VALUE FOR MONEY OFFERS



AIR MINISTRY COMMUNICATION RECEIVER R1155A. Brand New in transit cases. Frequency ranges—18.5-7.5 mcs, 7.5-3mcs, 1500-600 kcs, 500-200 kcs, 200-75kcs.

Complete with 9 valves and Magic Eye. Guaranteed absolutely perfect. Price £9/10 plus 10/- for packing and carriage.

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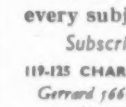

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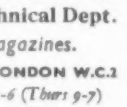

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SPECIFICATIONS :

Amplifier : Max. Gain, Peak to Peak = .3 volts per cm. **Frequency response** 10 c/s—100 k/c. Flat = 100 c/s to 50 k/c. **Time Base :** frequency range 5 c/s—30 k/c.

Dimensions : 8½ × 6½ × 11½. Weight 17½lb. Black crackle finish.
Price : Brand New, £14/14/-, carr. pd.
Now available as a Kit, £10/10/-, complete with valves, tube, cabinet, etc.

PYE 45 Mc/s STRIP. Special purchase of M.O.S. Type 3583 Units. Size 15in. × 8in. × 2in. Complete with 45 mc/s Pye Strip, 12 valves, 10 EF50, EB34 and EA50, volume controls and hosts of Resistors and Condensers. Sound and vision can be incorporated on this chassis with minimum space. New condition. Modification data supplied. Price £5, carriage paid.

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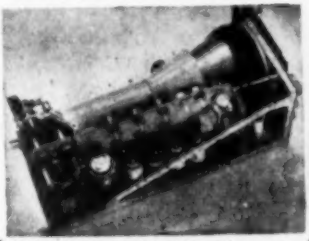

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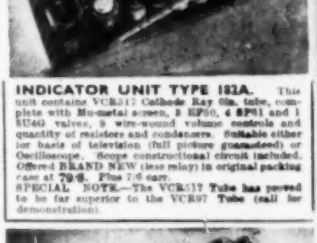

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These transformers are all famous radio manufacturers' surplus and are fully interleaved, impregnated and guaranteed.

Primary 200-250 v. P. and P. on each, 1/6 extra.

350-0-350, 100 mA., 4 v. 4 amp., 4 v. 2 amp., upright or drop-through, 16/-.

300-0-300, 100 mA., 6 volt 3 amp., 5 volt 2 amp., 25/-.

250-0-250, 80 mA., 6 v. 3 amp., 4 v. 2 amp., drop-through, 14/-.

Drop-thro' 350-0-350 v. 70 mA., 6 v. 2.5 amp., 5 v. 2 amp., 14/6.

250-0-250, semi-shrouded drop-through, 80 mA., 6 v. 3 amp., 5 v. 2 amp., 14/6.

Semi-shrouded, drop-thro', 280-0-280, 80 mA., 4 v. 6 amp., 4 v. 2 amp., 12/6.

Auto-wound, H.T. 280 volts at 360 mA., 4 v. 3 amp., 2 v. 3 amp., or 6 v. 3 amp. Separates 4 v. 3 amp., rectifier winding (upright or drop-through), 10/6.

350-0-350, 120 mA., 4 v. 4 amp., 4 v. 3 amp., drop-through, 21/-.

Auto-transformer, various combinations of voltages including 110 v. 70 watts, and 3/4 volt windings at 1 amp., 2 volt 1 amp., drop-through or upright mounting, 10/6.

250-0-250, 60 m A. 6 v. 3 amp., 12/6

250-0-250, 80 mA. 6 v. 4 amp., 14/-

Pri. 230 v. Sec. 200-0-200 35 mA. 6 v. 1 amp., 8/6.

Pri. 200/250 v. secondary 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24 and 30 volt at 2 amps., 13/-.

Heater Transformer. Pri. 230-250 v. 6 v. 1½ amp., 8/-; 2 v. 2½ amp., 5/-. 2, 4 or 6 v. at 2 amps, 7/6. P. and P. each 1/-.

P.M. SPEAKERS

	(Closed field) with trans.	less trans.
2½in.	—	15/6
3½in.	—	13/6
5in.	16/6	12/6
6½in.	16/6	12/6
8in.	18/6	15/-

P. and P. on the above 1/- each. 10in., less trans., 2/-. P. and P. 1/6.

R. & A. 8in. M.E. Speaker field coil, 1,600 ohms O.P. trans. 5,000 ohms, impedance, 10/6. Post and packing 2/-. Rola 5in. P.M. with O.P. trans., 16/6.

6½in. Energised Television Speaker by PLESSEY. Field resistance 68 ohms with humbucking coil. Will pass up to 300 mA., require minimum 200 mA. to energise. These are cheaper than a T.V. choke. 9/6 each, 2 for 18/-.

Volume Controls, by famous manufacturer. Long spindle less switch, 50K, 500K, 1 meg., 2/6 each. P. & P. 3d. each.

B.T.H. Crystal Diode wire ends, 2/3, post paid.

Expanded aluminium speaker fret, 13½ x 9in., 2/-.

Volume Controls by famous manufacturer. Long spindle and switch, ½, ¼, 1 and 2 meg., 4/- each; 50 K, 3/6 each. Ganged control 3K and 5K, 3/6. Post and packing 3d. each.

Trimmers, 5-40 pf., 5d.; 10-110 10-250, 10-450 pf., 10d.

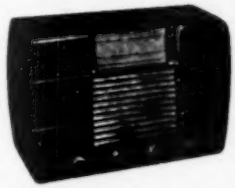
Ceramic P.F.S. 3 each of the following: 330, 220, 180 and 82, 2/6.

Twin-Gang .0005 Tuning Condenser, 8/-. With trimmers, 7/6. P. & P. 1/-.

D. COHEN

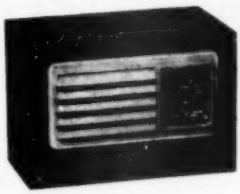
RADIO & TELEVISION COMPONENTS

SPECIAL OFFER—LIMITED QUANTITY—BRAND NEW GARRARD AUTOMATIC 3-SPEED RECORD CHANGER UNIT, model RC72A, type RC72A/AC, A.C. mains 100/250 v. Complete with two pick-up heads. £11/15/-, post paid.



WALNUT BAKELITE CABINET size 17½ x 12 x 8in., complete with 3-wave band scale, size 8½ x 3½in., 5 valve superhet chassis with I.F., valve holder and transformer cut-outs, pointer, drum, drive spindle, 4 knobs, 2 scale clips, 3 pulley wheels, two brackets, scale pan and back. **DESPATCHED TO ENGLAND ONLY,** 31/-, post paid.

CONSTRUCTOR'S POLISHED CABINET. Size 10 x 6½ x 5in. approx., supplied in flatted form, grooved and ready to glue together. Complete with plastic front, 3-valve chassis, size 8½ x 4 x 1½in., tuning scale, backplate and back. Illustration as it would look when assembled. Two knobs not supplied. 10/-. P. & P. 1/6.



TWIN-GANG AND PAIR OF TRF COILS with circuit to suit above, 8/6.

EX-GOVT. MARCONI CR.100 COMMUNICATION RECEIVER COIL UNIT, COMPLETE. 10-5,000 metres (approx.) in 6 bands complete with 4-gang condenser, 5 I.F.s, 1 osc. coil 27/6. P. & P. 3/-.

MAINS TRANSFORMER, semi-shrouded drop-through 200/250v. primary; secondary 280-0-280 250 mA., 6 v. 6 amps., 5 v. 3 amps., 29/6. P. & P. 3/-.

WATERHOUSE 5in. EXTENSION SPEAKER, complete with vol. control, in gold and green, 22/6. P. & P. 1/-.

KIT OF PARTS FOR SIGNAL GENERATOR. Coverage 110 Kcs.-320 Kcs., 320 Kcs.-900 Kcs., 900 Kcs.-2.75 Mcs., 2.75 Mcs.-8.5 Mcs., 8.5 Mcs.-20 Mcs. Metal case 10" x 6½" x 4½", size of scale 6½" x 3½". 2 valves and 1 rectifier valve, AC mains 230/250. Internal modulation 400 cps to a depth 30 per cent. Frequency calibration accuracy plus or minus 1 per cent. Modulated or unmodulated RF output continuously variable 100 millivolts. £3/10/0, P. and P. 4/-. This includes the return to us for checking and calibration, or we will build it for 15/- extra.

MAINS OR BATTERY SUPERHET PORTABLE COILS. Comprising medium-wave frame aerial and long-wave loading coil, used as aerial coils. Midget iron-cored screened L/M osc. coils, complete with circuit I.F. frequency 465 Kc., 9/6.

465 KC. MIDGET I.F.s. Q 120, size 1½in. long, 1in. wide, ¾in. deep by very famous manufacturer. Pre-aligned adjustable iron-dust cores, per pair, 12/6. Both these items £1, post paid.

CONSTRUCTOR'S PARCEL comprising chassis 8in. x 4in. x 1½in., with speaker and valveholder cut-outs, 5in. P.M. speaker with transformer, twin gang with trimmers, pair T.R.F. coils long and medium, iron-cored, four valveholders, 20 K. volume control and wave-change switch, 23/-. P. & P. 1/6.

6 IRON-CORED COILS on Aladdin formers 13.5-50 metres, 198-550 metres, 950-2,000 metres. Tuned with a .0005 gang, I.F. frequency 465 Kc. Complete with circuit, 8/6.

OUTPUT TRANSFORMERS. Standard type 5,000 ohms imp. 2 ohms speech coil, 4/9; 42-1 speech coil 2-ohm with extra feed-back winding, 4.3; Miniature 42-1 2-ohm speech coil, 3/3. Multi-ratio 3,500, 7,000 and 14,000 2-ohm speech coil, 5/6. 10 watt push-pull, 6V6 matching, 2 ohm speech coil, 7/-.

Twin-gang .0005 with separate 75 pf. on each section for S.W. tuning with feet, size 3½ x 3 x 1¾in., 6/6.

Television Chassis: Size 9½ x 9½ x 3½in., 18 gauge steel cadmium plated complete with 5-coil cans size 1½ x 1in. with iron-cored former. These are wound for television frequency. 6/6. P. & P. 1/6.

Push-back connecting wire. Doz. yds. 1/6 post paid.

Standard Wave-change Switches. 6-pole 3-way, 2/-; 4-pole 3-way, 1/9; 5-pole 3-way, 1/9; 3-pole 3-way, 1/9; 9-pole 3-way, 3/6; Miniature type, long spindle, 3-pole 4-way, 5-pole 2-way, 4-pole 3-way, 2/6 each. P. & P. 3d.

Line Cord. 3-way 0.3 amp. 180 ohms, per yard, 1/3 per yard.

Television Coils wound in silican, size 2½ x ⅝in. with former and iron core, 1/- each.

32 mfd., 350 wkg. 2/6
16 x 24, 350 wkg. 4/-
4 mfd., 200 wkg. 1/3
40 mfd., 450 wkg. 3/9
16 x 8 mfd., 500 wkg. 5/-
16 x 16 mfd., 500 wkg. 5/9
8 x 8 mfd., 450 wkg. 3/6
1 mfd., 500 v. wkg. 1/6
32 x 32 mfd., 350 wkg. 4/-
32 x 32 mfd., 350 wkg. and 25 mfd., 25 wkg. 6/6
2s mfd., 25 wkg. ..... 11d.
250 mfd., 12 v. wkg. 1/-
16 mfd., 500 wkg., wire ends 3/3
8 mfd., 500 v. wkg., wire ends 2/6
8 mfd., 350 v. wkg., tag ends 1/6
50 mfd., 25 v. wkg., wire ends 1/9
10 x 6 x 2 x 2 mfd., 500 v. wkg. 5/-
50 mfd., 250 v. wkg. 1/9
Ex-Govt. 8 mfd., 500 v. wkg., size 3½ x 1½, 2 for 2/6
60 + 100 mfd., 280 v. wkg. 7/-
16 x 32 mfd., 350 wkg. 6/-
50 mfd., 180 wkg. 1/9
65 mfd., 220 wkg. 1/6
4 + 4 + 4 mfd., 350 wkg. 2/6
8 mfd., 150 wkg. 1/6

Frame Oscillator Blocking Transformer, 4/6.

Frame O.P. Transformer. Inductance 10 hy. ratio 10 : 1, 9/6.

Tube Mounting Bracket, size 9½ x 4½in., with 4½in. dia. cut-out, in 18 gauge cadmium plated steel and 12in. tube clamps, 2/-.

Smoothing Choke, 2 henry 150 mA., 3/6.

Smoothing Choke, 250 mA. 4 henry, 5/-; 250 mA. 5 henry, 6/-.

P.M. Focus Unit for Mazda tube, 15/-. P. & P. 1/6. Similar to above with front adjustment, 2/6 extra.

P.M. Focus Unit for any 9in. or 12in. tube, 35 mm. neck, except Mazda 12in., state tube 12/6.

Similar to above, but with front adjustment, 2/6 each extra.

Ion Traps for Mullard or English Electric Tubes, 5/-, post paid.

Pre-Aligned Midget 465 Kc. Q. 120, 9/- per pair, post 6d.

465 Kc. I.F.s, size 2½ x 1½in. Q.110 removed from American equipment, 5/- per pair.

Iron-Cored 465 Kc. Whistle Filter, 2/6.

Standard 465 Kc. I.F.S. Q.120, iron-cored, 3½ x 1½ x 1¼in., per pair, 9/6.

Television Masks. White Rubber, 9in. with glass, 7/6. Cream rubber, 12in. with armour plate glass, 15/-; 15in. white rubber mask, soiled, 12/6, plus 1/6 P. and P.

Valve Holders. Paxolin international octal, 4d. each. Moulded international octal, 7d. each. EF50 ceramic, 7d. each. Moulded B7G, slightly soiled, 6d. each. B8A, 7d. each.

Two-piece Octal Screening Can, 9d. P and P. 3d.

Three-bank, 50 pf., 1/3. Four-bank, 50 pf., 1/8.

AMPLIFIER CHASSIS, 18 gauge aluminium, 5 valve holders, transformer and 2 electrolytic cut-outs, size 11½ x 7½in., sloping front, 4/- each.

Twin Gang Midget .00037 with perspex, dust-cover and trimmers, 8/6. Post and pkg. 6d.

Mains Droppers, 0.3 amp., 460 ohms, tapped 280 and 410, 1/6; 0.2 amp., 717 ohms, tapped at 100 ohms, vitreous, 1/6; 0.3 amps., 950 ohms, tapped 700 and 825, 2/6; 0.2 amp., 1,000 ohms, vitreous, tapped, 2/6. Vitreous .3 amp. 700 tapped 600, 640, 600, 3/6, P. and P. on each 3d.

3-gang .0005 with separate 75 pf. on each section for S.W. tuning with feet, size 4½ x 3 x 1¾in., 7/6.

Terms of Business: Cash with order. Despatch of goods within 3 days from receipt of order. Where post and packing charge is not stated please add 1/- up to 10/-, 1/6 up to £1, and 2/- up to £2. All enquiries and Lists. S.A.E.

SPECIAL NOTE: NO GOODS SENT WHERE CUSTOMS DECLARATION IS APPLICABLE.

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Hours of Business: Saturdays 9—4 p.m. Wednesday 9—1 p.m. Other days 9—5.30 p.m. *Telephone: ACOrn 4981*

RADIO EXCHANGE CO.

STROBE UNITS. With 6 EF50's, 5Z4, SP61, five EA50's, dozens of resistors, condensers, pots, relays, transformers, chokes, smoothing condensers etc. Brand new. ONLY **59/6**.

RECEIVER P40. Complete with valves, tuning 85-95 mc/s these are ideal for Wrotham or "2" metre conversion. Housed in attractive robust grey cases these contain 4 EF54's (RF, mixer, Xtal multipliers), EC32 (Xtal oscillator), 2 EF39's (2.9 mc/s IF), EB34 (det), 6I5 and 6V6 (audio). In original cartons, complete with circuit, **69/6**, post 1/8. Slightly soiled **49/6**.

TRANSMITTER 21. Sending CW, MCW or speech on 4.2—7.5 and 18—31 mc/s these are complete with circuit, control box, key and front panel. Wire (not formers) from PA coils, and relays, have been stripped by the M.O.S. but may easily be replaced with the aid of our circuits and data. In **excellent** condition (less valves). **15/-**.

VIBRATOR UNIT 21. 6 v. input, approx. 160 v. at 40 mA. smoothed DC output : designed for the Tx/Rx 21. In new condition. ONLY **17/6** (1/11 post).

INDICATOR 182A. With VCR517 6in. tube, 3 EF50's, 6 SP61's, 5U4, 9 pots, resistors, condensers, etc. Ideal for television or scope. New in crates (less relay). **79/6**.

BRAND NEW ACCUMULATORS in transparent, unspillable plastic cases. 7 A.H. 2 v., 3in. x 1¼in. x 4in. **6/6** (1/- post).

NEW 1355 CONVERSION, NEW EDITION of our data, for all 5 TV channels. **2/-**

1355 RECEIVERS complete with 11 valves, BRAND NEW, in original cases, **45/-**.

1155 COMMUNICATION RECEIVERS, unused in original transit case, **£10 15/-** (Air Tested).

MIDGET AMPLIFIERS with two 12SH7's, one 12SJ7, these measure 5in. x 3¼in. x 3in. OUR PRICE **12/6** (post 1/9).

HEMISPHERICAL CARBON MICROPHONES with switch, new, boxed, **5/-**, post 5d.

MALLORY 4-PIN VIBRATORS. 12 v., non-sync **5/-** (post 9d.)

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1 KW TELEGRAPH TRANSMITTERS. Two HF 300's output. Operation 3.5 mc. to 16 mc.

RCA TRANSMITTERS. Type ET-4336. Complete with speech amplifier, crystal multiplier and VFO units. Unused and re-conditioned. Can be supplied with very large quantity of spares.

RCA TRANSMITTERS. Type ET-4332 modified by R.A.F. for use on crystal or master oscillator. Complete with speech amplifier.

EX R.A.F. 1143 TRANSMITTERS.

NAVY MODEL COLLINS TRANSCEIVERS. TCS9. Completeness.

No. 12 TRANSMITTERS. With coupling units, remote control, etc.

A.R.88's, A.R.77's, S27's, HRO and others.

AUTOMATIC HIGH SPEED TELEGRAPH EQUIPMENT, "BOEHME" (U.S.A.). Up to 400 signs per minute on line and wireless.

NAVY MODEL TBY-8 TRANSMITTING-RECEIVING EQUIPMENT. Output 0.75 watts on M.C.W. telegraphy and 0.5 watts on telephony. Frequency range 28-80 mc.

All above items in excellent working condition.

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TX VALVES 803, 805, 807, 814, 861, 866A, DET-16 and many others.

Large stock of Tx condensers, crystals and other components. Alignment and repair of communication receivers and all other short-wave equipment undertaken.

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Built to your requirements. Large stocks held.

VOLTAGE REGULATORS. Input 230 volt A.C. 21 amps., output 57.5 to 228 volts in 16 Steps. With current limiting Reactor. **£15.**

VARIAC TRANSFORMERS. Type 80 CO. Input 200/240 v. Output 220 v. 7.5 amps. **£7 10/-** each.

SIGNAL AND NOISE GENERATOR. For Television frequencies 20-80 Mc/s in 5 Bands. Crystal controlled. Leaflet available on request. Price **£14 10/-**.

WHEATSTONE BRIDGE. Accuracy 0.01%. Five decades of "Thousands," "Hundreds," "Tens," "Units," "Tenths," with rotary switch ratio arm adjustments. Made by H. W. Sullivan Ltd.

POTENTIOMETERS. Wire wound and carbon, best makes, 50,000 in stock, also Resistors, Condensers etc.

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MODEL AC10E £10 7 3

AMPLIFIERS. College general purpose suite. **MODEL AC10E,** 4 valve 10 watts. Neg feedback. **£10 7 6. MODEL AC15E,** 6 valve 15 watt P/P output. Feedback over 3 stages. **£15 5/-. MODEL AC25E,** 20 watts P/P output. Feedback over 3 stages. **£18 18/-. MODEL U10E,** for DC/AC mains 6 valve 10 watt P/P output. Feedback over 3 stages. **£12 19 6.** All are complete with cases and chrome handles. They have a separate microphone stage. Separate inputs for mike and gram., allowing individual mixing, etc. Outputs match 3, 8 or 15 ohms speakers. Max. inputs volts required for full stated output: average Mike .005, Gram. 3 v. **MODEL AC8C,** 5 valve P/P 5-10 watt unit for remote radio, etc. Feedback over 2 stages. Outputs to 3, 8, 15 ohms **£10 10/-. MODEL AC4C,** 3 valve record unit & amplifier, 4 watts to 3 ohms. **£9 15/-.** Units U4C for DC/AC mains **£8 15/-.** Stamp for list. Full range of accessories available including: Rothermel Crystal Mikes, **10/6**; Goodmans 12in. P.M. speaker, **£8 18 6**; Collaro A.C. Record Players, rim drive, magnetic model, **£6 9/-**, Crystal, **£6 15/-**. Jack plugs **2/-** each extra.

All amplifiers are complete and ready for use.

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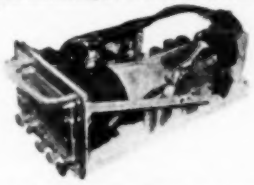

Type 6 which contains a 6in. C.R.T. Type VCR97, 4 valves EF50, 1 of EB34 and 1 of EA50. The " Wireless World " leaflet containing full details for conversion to general purpose 'scope supplied free with each unit (or available separately 1/- post free). ONLY **79/6**, plus 7/6 carriage.

Type 182A. This is probably better value as it contains more valves and components. The tube employed is your old favourite the VCR517. This is a 6½in. electro-static tube which can be used for 'scope work or gives an exceedingly pleasant picture when used for T.V. It is used in exactly the same manner as the VCR97 and employs the same voltages, base connections, etc. It does not suffer from cut-off and in our opinion gives a picture equal to, or better than, the VCR97. Call during viewing hours and see for yourself. Complete with three EF50s, one 5U4G, four SP61s, etc. (less relay). It is extremely cheap at only **79/6**, plus 7/6 carriage in original transit box. BRAND NEW. " Wireless World " 'scope leaflet supplied free with each unit.

COMMUNICATION RECEIVER Type R1155.
Now world renowned as one of the finest receivers obtainable. For those not familiar with the set we can supply an authoritative " Wireless World " circuit and descriptive leaflet at 1/3 post free. All our receivers are air tested before despatch and are supplied complete with 10 valves. Any receiver gladly demonstrated to callers. The price is **£11/19/6**, and for an additional **10/6** the set is despatched in maker's transit case. ABSOLUTELY BRAND NEW. A few only, slightly used, air tested for only **£7/19/6**, plus 10/6 carriage.

A.C. MAINS POWER PACK/OUTPUT STAGE.
Enables this receiver to be operated direct from A.C. mains. Just plug in and connect low impedance speaker (speaker not included). **£4/10/-**, plus 3/6 carriage. This unit is manufactured by ourselves from first class new components and valves, and is assembled in a neat black case 8½in. x 6½in. x 4in. All the necessary leads and Jones plug supplied and included in the price. NOTE—OUR POWER PACK IS GUARANTEED SIX MONTHS.

Note: R1155N STILL AVAILABLE. Price **£17 - 19 - 6 plus 10/6 carriage.**

££ SAVE MONEY ££

Brand new R1155, A.C. mains Power Pack and Output stage complete for ONLY £15/19/6, plus 12/6 carriage and packing. Offer does not apply to " N " Model.

TRANSFORMER BARGAINS ALL GUARANTEED

Ex-Admiralty—Primary 230 volts, 50 cycles. Secondary—4 volts. Centre tapped at 20 Amps. Insulation 8kV. Bakelite panels slightly damaged, O.K. electrically. Upright mounting, size 4in. x **4½in. x 6½in. high. For** soil heating, etc. Price **22/6** plus 2/6 post.

Ex-Admiralty—Primary 230 volts 50 cycles. **Secondary—7-0-7** volts 12 Amps. 7-0-7 volts, 12 Amps. Total 336VA. 4kV insulation. Upright mounting, size 5in. x 5½in. x 7in. high. For welding, soil heating, charging etc., as up to 28 volts at 12 Amps are available. Price **45/-** plus 5/- carriage

Ex-W.D. Primary 230 volts 50 cycles. Secondary—330-0-330 volts 150mA. 4 volts 3 Amps. Size 4in. x 4in. x 4½in. Price **13/6** plus 1/6 post.

Plate Transformer, ex-W.D.-potted. **Primary tapped every 10** volts from 100 to 250 volts. Secondary 2000-0-2000 volts R.M.S. Rating 1kVA Weight 82lbs. Size 10in. x 10in. x 9½in. Brand new—**£3.5/-** plus 15/- carr.

Miniature Mains Transformer—Primary 230 volts 50 cycles, Secondary 230-0-230 volts 50mA, 6.3 volts 2.6 Amps. Suitable for small sets, instruments, etc. Upright mounting, size 2½in. x 2½in. x 3in. high. Price ONLY **10/-** plus 1/- post. Brand new and boxed.

Power Pack Parcel—contains one of above trans., 6X5 rectifier valve, choke 8-8 mF, smoothing condenser, valve holder and toggle switch. ALL BRAND NEW items for ONLY **25/-** post paid.

Standard Mains Trans. 200/230/250 volts 50 cycles primary, secondary 325-0-325 volts 70 mA., 6.3 volts 2.5 Amps, 5 volts, 2 Amps. Half shrouded drop through with mains panel. Size 4in. x 3½in. Brand new, boxed at **12/6** plus 1/6 post.

Power Pack Parcel—contains one of above 325 volt trans., 5Z4 rectifier choke, 8-16 mF. condenser valve holder and toggle switch. All Brand New for **30/-** post free.

E.H.T. Transformer for VCR97, VCR517, etc. Mains input 230 volts 50 cycles. Output 2,500 volts 5 mA., 4 volts 2 Amps., 2-0-2 volts 2 Amps., FULLY GUARANTEED only **35/-** post 1/-.

30 Volt Transformer—Standard primary, secondary 30 volts 2 Amps., tapped to give 3, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24 and 30 volts. Has countless uses, i.e., for chargers, filament trans., etc. Price **17/6** plus 1/- post. Fully guaranteed. Brand new and boxed.

Metal Rectifier, suitable for above trans., 12 Volt 2½ Amp. Full wave bridge type. Price **12/6** plus 1/- post.

TELEVISION

R1355 Receiver. The justly famous receiver unit specified in the " Inexpensive T.V." book. Valve line-up: 8-SP61, 1-VR92, 1-VU120 and a 5Z4. BRAND NEW for **39/6**, plus 7/6 in transit box.

RF Units for the R1355. We can supply the RF24 or RF25 modified to the frequency you require. Any station, sound or vision for **32/6**, plus 2/6 carriage.

Special Offer of brand new R1355 and RF unit tuned to frequency required for only **£3/10/-** carriage paid. The cheapest way of making that TV set.

6in. Magnifying Lens for the VCR97, SCP1, etc. First grade, oil filled perspex, special price **19/6**, plus 1/6 post. Almost doubles your picture area.

Coaxial Cable. Brand new 75-80 ohm at 1/- per yard—**minimum 10 yds.** by post. This is standard ½in. dia.—not ex-Govt.

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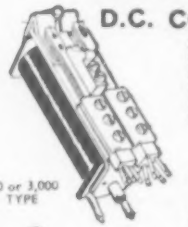

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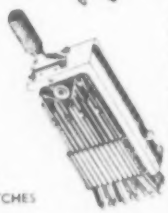

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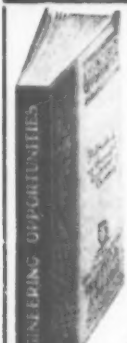

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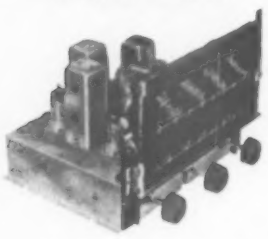

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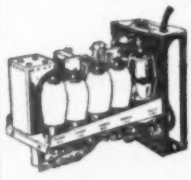

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TUBULAR condensers, 1mf 350vw, 6/6 doz. 1,000 vw, .01mf, 7/- doz. .001mf, 5/- doz. also vibrators, valves, key-switches, radio and T.V. cabinets, low prices, send us list of your wants, money-back guarantee.—Renus Electric Ltd., Clarence Place, Newton Abbot, Devon. [0214

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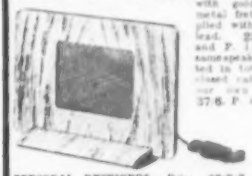

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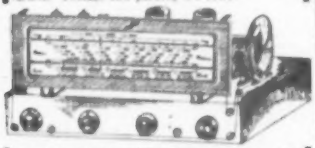

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WALNUT radiogram cabinets; stamp details.—S. Winker, 501, Ha-e End Rd., Highams Park, E.4. [9009

WALNUT radiogram and television cabinets, soundly constructed; stamp details.—R. Shaw, 69, Pallrop Rd., Leytonstone, E.11. [8897

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BC610 Hallicrafters, also spares; RCA ET 4336 series with spares; BC348 receivers, also TCS6, TCS12 and components.

McELROY ADAMS MFG. GROUP, Ltd., 46, Greyhound Rd., W.6. Tel. Fulham 1158-9. [0197

WANTED, receivers A.P.R.4, also T.N. 16, 17, 19, etc., any, any radio test gear.—LESLIE DIXON & CO., 214, Queenstown Rd., Battersea, S.W.8. Macaulay 2159. [0176

PREPAYMENT slot meters wanted, suitable T.V. L - 50 mins. basis price.—Box 2621. [9107

VALVES, type 815 (R.C.A.), urgently required by manufacturing concern.—Box 1642. [8892

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PLUGS and sockets, all kinds bought for export by agent of a U.S. company.—Write Box 1636. [9167

WANTED, quantity valves, type 805 and 866A. 805 must be either R.C.A. or G.E. manufacture.—Box 8765. [8765

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WANTED, laboratory test equipment, including standard signal generator, watt meter, oscilloscope, bridges, recorders; send price and details to—HATFIELD INSTRUMENTS, 175, Uxbridge Rd., Hanwell, W.7. Tel. Ealing 0779. [0037

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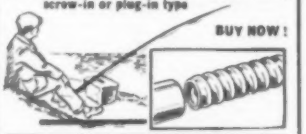

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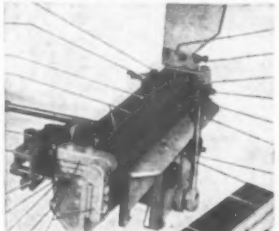

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MAINS TRANSFORMERS (NEW), input 200/250 volts in steps of 10 volts, output 350-0-350 volts 300 m/amps, 6.3 volts 8 amps twice, 4 volts 4 amps, 5 volts 4 amps, **70/-** each, carriage 3/6; ditto, 450-0-450 volts 250 m/amps, 6.3 volts 8 amps twice, 4 volts 4 amps, 5 volts 4 amps, **70/-** each, carriage 3/6; another, input as above, output 500-0-500 volts 250 m/amps, 6.3 volts 8 amps twice, 6.3 volts 4 amps, 4 volts 4 amps, 5 volts 4 amps **75/-**, carriage 3/6. Another wound to (electronic) specifications, 350-0-350 volts 250 m/amps, 4 volts 8 amps, 4 volts 4 amps, 6.3 volts 8 amps, 0-2-6.3 volts 2 amps, **70/-** each, carriage paid; another input as above, output 500-350-0-350-500 volts 250 m/amps, 6.3 volts 6 amps, 0-2-6.3 volts 2 amps, 0-4-5 volts 4 amps twice, **75/-** each, carr. 3/6.

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SITUATIONS VACANT

ADMIRALTY, Royal Naval Scientific Service. ENGINEERS and Physicists (particularly with electronics) required for appointments in (a) Senior Scientific Officer and Scientific Officer grades (Ref. A246/52A), and (b) Senior Experimental Officer, Experimental Officer and Assistant Experimental Officer grades (Ref. A247/52A) in Experimental Establishments in London, Portsmouth, Weymouth areas and Scotland. Candidates, British subjects, for (a) must possess first- or second-class honours degree in Physics or Engineering, or high professional attainments such as corporate membership of appropriate professional institution with suitable experience and responsibility and for (b) should possess one of following qualifications: University degree in Science, Engineering or Mathematics, Graduate membership of appropriate professional institution, Higher National Certificate, Final certificate of five-year grouped course in relevant subject at City & Guilds of London Institute or comparable institution, Higher School Certificate with Mathematics or Science as principal subject or equivalent qualification, S.S.O.s at least 26 years of age with at least three years' approved experience. London salary scale (men) £750—£950 per annum; S.O.s at least 21 years £400—£650; S.E.O.s at least 35 years £780—£1,000; E.O.s at least 26 years £575—£725; A.E.O.s at least 17½ years £250—£555. Rates for women and posts in Provinces somewhat lower. Starting salaries above minima may be granted according to age and experience. Salaries carry superannuation or approximately 10% on the first £500 plus 5% on second £500.
ALL appointments unestablished (with F.S.S.U. for S.S.O. and S.O.) but with some opportunities to compete for established posts. Application forms etc., from M. of L. & N.S., Technical and Scientific Register (K), Almack House, 26, King St., London, S.W.1, quoting appropriate reference. [9154

FERRANTI, Ltd., Moston, Manchester, have the following vacancies for work in connection with the development of
CATHODE RAY TUBES for Television, Oscillography and special purposes:—
(1) SENIOR engineers and scientists to take charge of research and development sections. Applicants should have a good degree in physics, electrical engineering or equivalent technology and have had experience in supervising development work. Salary according to qualifications and experience, in the range £750 to £1,250 per annum. Please quote reference OCT/1.
(2) ENGINEERS and scientists for work in the following fields:—
Thermionic emission, vacuum techniques, electron optics, photo-electric phenomena, electronic circuits, glass technology and high-voltage techniques.
Qualifications include a good degree or equivalent. Previous experience would be an advantage, though not essential. Salary, according to qualifications and experience, in the range £450 to £1,000 per annum. Please quote reference OCT/2.
(3) MECHANICAL or production engineers to undertake the development of machinery for mass-production of electronic devices. Qualifications etc. as in (2). Please quote reference OCT/3.
(4) TECHNICAL assistants for experimental work in the fields listed in (2) above. Qualifications are a degree or Higher National Certificate. Salary range £400 to £600 per annum according to age and qualifications. Please quote reference OCT/4.
The Company has a Staff Pensions Scheme.
Application forms to Mr. R. J. Hibbert, Staff Manager, Ferranti, Ltd., Hollinwood, Lancs. Please quote appropriate reference. [8975

WANTED.—First-class radio and television engineer, permanent.—E. P. Fox, Ltd., East Molesey, Molesey 1281. [9208

EXPERIENCED component engineers are urgently required by a large Midland firm for work of national importance.
APPLICANTS selected will be required to build up a new section specialising in selection and design of electrical and mechanical components for electronic equipment, together with associated light and medium heavy control gear, transformers and wiring; applicants should have a full working knowledge of service specifications and type approval procedure, experience of component design and an understanding of ratings.—Please write, giving full details of experience and qualifications and quoting reference 1 H F to Box 2401. [9057

A LARGE and well established engineering company require personnel as shown hereunder for their newly formed laboratory:—
1. SENIOR design and development engineers. Degree or A.M.I.E.E. standard with at least 5 years' industrial experience; applicants should have an extensive knowledge of the communications, radio or Post Office relay design fields.
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3. SENIOR design draughtsmen with experience of light electro-mechanical engineering.
4. JUNIOR design draughtsmen, 25 years plus.
APPLICATIONS are invited from men of sufficient experience and ability to justify very good salaries; these vacancies are of a permanent and progressive nature; staff pension scheme in operation, please write, in confidence giving details of qualifications, etc., to—Box 2989, quoting reference L.50. [9165

TELEVISION service engineers required N.W. Kent; first-class enthusiasts only; top rates and good conditions.—Television Maintenance Co., 61, High St., Orpington. Tel. Orp. 5757. [9171

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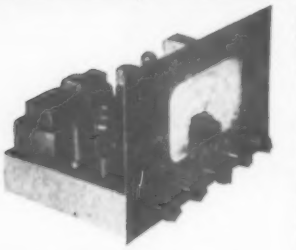

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POWER UNITS TYPE 8. High grade power units operated from 200-250 v. 50 c/s. A.C. mains. Outputs are approx. 200 v. smoothed D.C. at 70 mA. and 6.3 v. A.C. at 4 a. Designed for use with the R.1132 and R.1481 but quite suitable for most communication receivers. Made for rack or bench mounting, panel size 19in. × 7in. And depth over dust cover 11in. Front panel is fitted with 0-150 m.A. for indicating output current and fuse cover giving access to fuses for both input and output. A two section filter gives a high degree of smoothing. Interior metal work may be a little store soiled but external appearance is good and all units are tested before despatch to ensure proper working order. Supplied complete with rectifier valve (VU39) plugs for input and output and circuit diagram pasted on inside of dust cover. **PRICE 84/-,** carriage 7/6.

POWER UNITS TYPE 159. Contain rotary converter for 24 v. D.C. input and having a twin D.C. output of 12 v. at 7 a. and 300 v. at 70 mA. Fitted with carbon pile voltage regulator, pots., 8 mfd. electrolytics, 2-stabiliser valves type CV45, etc. By altering field winding connections (Details supplied) this convertor can be run from 12 v. or A.C. or D.C. mains. Direction of rotation is also reversible. Supplied unmounted apart from its original fix for driving small models or as a fan. **PRICE 22/6,** carriage free.

THIS MONTH'S BARGAIN OFFER. To free storage space we are offering brand new **INDICATOR UNITS TYPE 188** (Less relay) at a clearance price. They are fitted with a 6in. cathode ray tube type VCR517 suitable for either TV or Scope and which we test to ensure freedom from cut-off. 2-VR91's, 1-U.14, 4-VR65's, 8-wire wound pots., and a wealth of other useful parts. **PRICE 65/-,** carriage 6/6.

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Telephone: Shepherds Bush 1729

SITUATIONS VACANT

RADIO and television, Cole Brothers Ltd., of Sheffield, require experienced salesmen in their radio and television Department. GOOD commencing salary and excellent prospects for suitable applicants, pension scheme, canteen facilities, 3 weeks' annual holiday.—APPLICATIONS in first instance by letter to Staff Engager, stating age, qualifications and salary required. [9157

SENIOR Electronic Development Engineer required to take charge of engineering associated with guided weapons and like projects. ELECTRONIC Development Engineers also required for the same projects.—REPLY, stating age qualifications and experience, to Staff Manager (Ref. R.O.), G.E.C. Stanmore Laboratories, The Grove, Stanmore Common, Stanmore, Middlesex. [9155

EXPERIENCED television engineer required. Accommodation provided; permanency for good man.—Courtenay Davis, Ltd., Station Rd., Harpenden. [9187

SKILLED instrument mechanics (physical): Research and experimental mechanics urgently required by Ministry of Supply at Sellafield, Cumberland.
APPLICANTS must have served a recognised relevant apprenticeship and have experience of industrial instruments used in measurement and control of temperature, specific gravity, PH and flow. Knowledge of vacuum techniques and measurement of gaseous properties an advantage. Rates of pay for 44-hour 5-day week: 145/9 on entry with early assessment for merit pay. Merit pay agreed after first assessment will be applied from entry date. Possibility of advancement to 187/9.
APPLY, giving details of apprenticeship, training (including any Forces' training), qualifications and experience, to Senior Labour Manager, Windscale Works, Sellafield, Cumberland. [9151

SKILLED instrument mechanics (general): Research and experimental mechanics urgently required by Ministry of Supply at Sellafield, Cumberland.
APPLICANTS must have served a recognised relevant apprenticeship and have experience of relay circuits and automatic telephone exchange maintenance. Knowledge of X-ray and electrical measuring apparatus an advantage.
RATES of pay for 44-hour 5-day week: 145/9 on entry with early assessment for merit pay. Merit pay agreed after first assessment will be applied from entry date. Possibility of advancement to 187/9.
APPLY, giving details of apprenticeship, training (including any Forces' training), qualifications, and experience, to Senior Labour Manager, Windscale Works, Sellafield, Cumberland. [9152

SKILLED instrument mechanics (electronic): Research and experimental mechanics urgently required by Ministry of Supply at Sellafield, Cumberland.
APPLICANTS must have served a recognised relevant apprenticeship and have sound theoretical knowledge of electronics (Ordinary National Certificate standard desirable) with practical knowledge of Pulse Amplifiers, D.C. Amplifiers, electronic scalers, discriminations, and general trigger circuits, and in wiring and assembly of electronic apparatus. Experience of test gear and general instrument calibration an advantage.
RATES of pay for 44-hour 5-day week: 145/9 on entry with early assessment for merit pay. Merit pay agreed after first assessment will be applied from entry date. Possibility of advancement to 187/9.
APPLY, giving details of apprenticeship, training (including any Forces' training), qualifications, and experience, to Senior Labour Manager, Windscale Works, Sellafield, Cumberland. [9153

DRAUGHTSMEN.—Air Trainers, Ltd., require several senior and junior electrical and mechanical draughtsmen for work in connection with the development of flight simulators as follows:—
(a) ELECTRICAL Draughtsmen for design work on electronic servo amplifiers.
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PERSONNEL Officer, Air Trainers, Ltd., Bicester Rd, Aylesbury, Bucks. [9012

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FOREMAN in electronics department, having good practical and technical knowledge and experience in radio engineering, required by firm in West Midlands; applications to—G. S. M. Box 2691. [9143

INSPECTOR of electronic components and equipment required by manufacturer N.W. London, knowledge of A.F.D. and I.E.M.E. procedure an advantage, please write stating age, experience.—Box 2940. [9157

ELECTRONIC Design Draughtsman for growing firm of industrial electronic control manufacturers; ground floor job for enthusiast with experience.—Econtrol, Ltd., Wilbury Way, Hitchin, Herts. Hitchin 1595. [9038

ELECTRONIC technician required by Oxford University laboratory to design, construct and maintain apparatus and test-gear used for research; experience of electronics other than radio desirable; wages according to University scale.—Apply, giving full details, to Box 3015. [9180

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RECEIVERS Type R1155. Complete with 10 valves. As new and in Transit Case. **£9/10/-.**
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RECTIFIERS. 12 volts 7½ m a full wave Bridge Connected Spindle Type. 12 stacks to make 6 Rectifiers as above, special price, **7/6** dozen.
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Pre-fab Kitchen Control Units. 20 x 11 x 3½in. Comprising:—Fuse Box, 6 fuses. Main Switch. Cooker Switch. Immerser Switch. Kettle Switch and 5 amp. 3-pin socket. Light Switch with 2 Indicators. Brand new. Cream, **20/-** including delivery.

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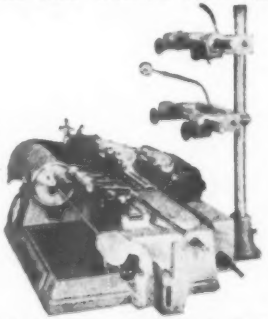

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1. PULSE Generation and Transmission.
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TECHNICAL assistant possessing higher national certificate required by company in North West Kent mass producing Cathode Ray Tubes; experience in such work essential: write giving full particulars to Box 2721. [9113

TELEVISION and radio designers required by well-known U.K. concern, excellent opportunity for qualified engineers who desire to emigrate; initial interview in England after sending full particulars and qualifications to—Box 2450. [9065

RESEARCH and development group studying industrial applications for electronics, electro-mechanisms and instrumentation require full or part-time technicians to investigate particular projects; write in first instance Box 2698. [9109

HARRODS, Knightsbridge, have a vacancy for a young man, completed National Service, to start in radio service reception and then to complete training in the radio engineering department.—Apply Staff Manager, 44, Hans Crescent, S.W.1. [9172

LEADING component manufacturer has vacancies for electronic designs engineers in the sales department; duties are liaison with Government and industrial authorities and radio and television designs engineers; ownership of car essential.
SALARY £600 a year plus commission and expenses; compulsory contributory pension scheme.
APPLICATIONS to state (in confidence) qualifications and experience to Box 2720. [9112

VIDOR, Ltd., Erith, have vacancies for senior and junior draughtsmen with good engineering background, with a flare for designing in mechanical and/or electrical field.—Apply to Personnel Manager, giving details of age, training and experience. [9125

TRIALS Assistants required for guided missiles by prominent engineering organization in Northern Ireland. Applicants should have served a recognised apprenticeship or equivalent, and have had good practical experience of one or more of the following:—
(a) ELECTRONICS, radar or television.
(b) LIGHT electrical equipment.
(c) PRECISION mechanical or hydraulic apparatus.
EX-N.C.O.s of technical branches of the Services considered. Applicants must be prepared to travel. Reply stating age and experience to—T.T.I., Box 2619. [9104

TECHNICAL writers for research dept. of electronic engineers in N. London region must prof. hold decrystate having equivalent and good practical knowledge of electronics; write stating present salary and experience to—Research Manager, Box 2907. [9144

AIRCRAFT radio mechanics required, experience in modern aircraft installations essential and knowledge of American radio installations and equipment an advantage.—Apply by letter to Field Aircraft Services, Ltd., Nottingham Aerodrome, Tollerton, Notts. [9195

EXPERIENCED radio testers and inspectors required for production of communication and radio apparatus; also instrument makers, wirers and assemblers for factory test apparatus.—Apply Personnel Manager, E. K. Cole L'd., Ekco Works, Malmesbury, Wilts. [9256

SENIOR electronic engineer required, experience of helicopter instrumentation and analogue computors would be an advantage.—Apply stating experience, age, etc., to the Personnel Officer, Saunders-Roe, Ltd., Southampton Airport, Eastleigh, Hants. [8851

TECHNICAL assistants experienced in dealing with electronic measurement and instrumentation, required for work on aero engines and their application, candidates aged between 25 and 30, possessing degree or diploma, and willing to deal with problems during flight preferred.
APPLICATIONS stating age, qualifications, and details of experience should be addressed to the Divisional Personnel Manager the Bristol Aeroplane Co., Ltd., Engine Division, Filton House, Bristol. [8818

RESEARCH Engineer required for television development laboratory; previous experience with reliable manufacturer essential.—Write, giving details of age, qualifications and salary required, Personnel Manager, Vidor, Ltd., West Street, Erith, Kent. Applications treated confidentially. [9124

CHIEF Inspector required. Applicants must have a sound basic knowledge of radio theory and be conversant with VHF and Radar.—Applications should be made in writing, giving full details of experience and qualifications, to Personnel Manager, Murphy Radio, Limited, Welwyn Garden City. [9129

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SENIOR Television Development Engineer required for research laboratory by well-known manufacturer in South-East London.—Write, giving details of age, qualifications, previous experience and salary required, to Personnel Manager, Box 2792. All applications will be treated strictly confidentially. [9125]

AN estimator is required by the Midlands switchgear department of a well-known company; applicants must have previous experience in this type of work; H.N.C. would be preferred, although not an essential requirement.—Please write, giving full details and quoting reference A.J.C./3, to Box 2793. [9124]

RADIO service mechanics are required by E. Smith & Sons (England), Ltd., of Cricklewood, N.W.2, starting at £5/5 per week, plus profit sharing bonus.—There are good prospects of advancement together with canteen facilities and a five-day week.—Write for interview to Personnel Officer (Radiomobile). [9043]

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SENIOR mechanical design draughtsmen required with experience of electronic layouts for work on guided weapons and like projects.—Reply, stating age, qualifications and experience, to Staff Manager (Ref. R.G.), G.E.C. Stanmore Laboratories, The Grove, Stanmore Common, Stanmore, Middlesex. [9146

TECHNICAL writers required by progressive electronic manufacturers in North London for preparation of research reports, service manuals, etc.; degree standard preferred, good knowledge of electronic equipment and radio development work and experience of technical writing necessary or evidence of ability.—Write Box 3009. [9179

ELECTRICAL assistant required for an industrial research laboratory in the S.E. London area, to help with problems connected with furnaces and control equipment; national certificate in electrical engineering a minimum requirement, with some knowledge of electronics an advantage; write giving full details to Box 2675. [9110

GLOSTER AIRCRAFT Co., Ltd., of Hucclecote, Glos., have vacancies for electrical draughtsmen; previous aircraft experience an advantage but not essential; prospects are excellent for energetic and sound applicants.—Applications to be addressed to the Chief Designer, giving particulars of experience, age and salary required. [9229

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A COST estimator is required by the Midlands industrial electronics department of a well-known company; applicants should possess H.N.C. or similar qualifications and be able to draw up equipment schedules and pre-costs; previous experience in electronic engineering is essential.—Please write, giving full details and quoting reference I.B.C., to Box 5016. [9181]

MECHANICAL engineers required for aero engine vibration investigations; previous experience desirable but not essential; must have knowledge of electronics; applicants should be graduates or at least hold the Higher National Certificate in Engineering.—Write, stating age, experience and salary required, to the Labour Manager, Rolls-Royce, Limited, Derby. [9164]

EXPERIENCED high-class electronic fitter & wiremen required for research and development work at The English Electric Co., Stafford; ex-H.M. Forces personnel with experience of radio and radar considered; good working conditions, canteen facilities, non-contributory life insurance and pension schemes; eligibility according to rules; hostel accommodation available. [9116]

APPLY quoting Stafford M. of L. Order No. 56 to Ministry of Labour and National Service Office, Stafford, or any M. of L. Office. [9055]

SENIOR technician with a thorough knowledge of electronic engineering, and N.H.C. or equivalent qualification required to develop and construct prototype and experimental apparatus for use in research; salary scale £455×20 to £565.—Apply in writing to the Director, Radiotherapeutic Research Unit, Hammersmith Hospital, London, W.12, quoting the names of two referees. [9118]

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EXPERIENCED men (ex-service radar mechanics preferred) are required for duties in the electronics division of Saunders-Roe, Ltd.; applicants should be capable of intelligent assembly and wiring of a wide variety of electronic apparatus from circuit diagrams.—Write, giving details of experience, age etc., to the Personnel Officer, Saunders-Roe, Ltd., East Cowes, Isle of Wight. [9092

T.C.C. invite applications for the positions of technical sales representatives in the radio, electronic and electrical industries; applications should state in detail their age, qualifications, experience, and salary required; only first-class men are being entertained—preferably those with previous experience in the industry.—Write (in confidence) to Sales Director, The Telegraph Condenser Co. Ltd., North Acton, W.3. [9162

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BELLING & LEE, Ltd., Cambridge Arterial Rd., Enfield, Middlesex, require research assistants in connection with work on electronic components, fuses, interference suppressors and television aerials; applicants must be graduates of the I.E.E., or have equivalent qualifications together with similar laboratory experience; salary will be commensurate with previous experience; 5-day week, contributory pension scheme.—Applications must be detailed and concise and will be treated as confidential. [9230

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THE ENGLISH ELECTRIC VALVE Co., Ltd., Chelmsford, Essex, has several attractive vacancies, junior and senior, for physics and engineering graduates to undertake research and development work on vacuum tubes; applications from graduates who have recently qualified as well as those with industrial and research experience will be considered; please write, giving full details, and quoting ref. 419F, to Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham St., London, S.W.1. [9117

THE PLESSEY Co., Ltd., has vacancies in its telecommunications engineering department for senior engineers and draughtsmen to work on long term private wire systems and defence projects; qualifications for senior engineers are a degree in Physics or Engineering and at least two years' experience in electronic, radio or radar development work; six or more years' experience of advanced work in the above field will be accepted as an alternative to a degree; qualifications for draughtsmen are at least two years drawing office experience on electronic, radio or electro-mechanical devices; the positions are permanent and pensionable and very good salaries are available for experienced men; applicants should be of British birth and nationality and will be required to work either at Ilford or at the company's laboratories near Witham, Essex.—Apply in confidence to the Personnel Manager, The Plessey Company, Vicarage Lane, Ilford. Quoting reference T.E.D. [9131

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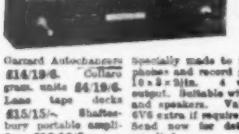

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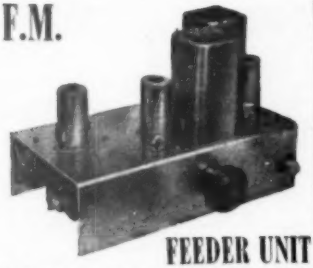

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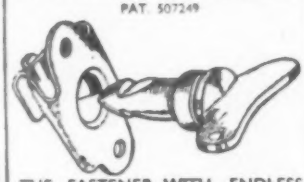

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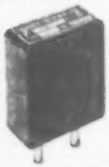

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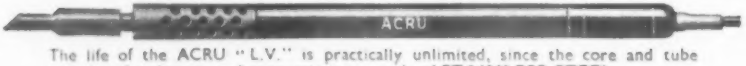

The life of the ACRU "L.V." is practically unlimited, since the core and tube carrying the element and connections are made of **STAINLESS STEEL.**

Ask for New Leaflet

THE ACRU ELECTRIC TOOL MFG. CO., LTD.,

CHAPEL STREET, LEVENSHULME, MANCHESTER, 19 *Tel. RUSholme 4613*

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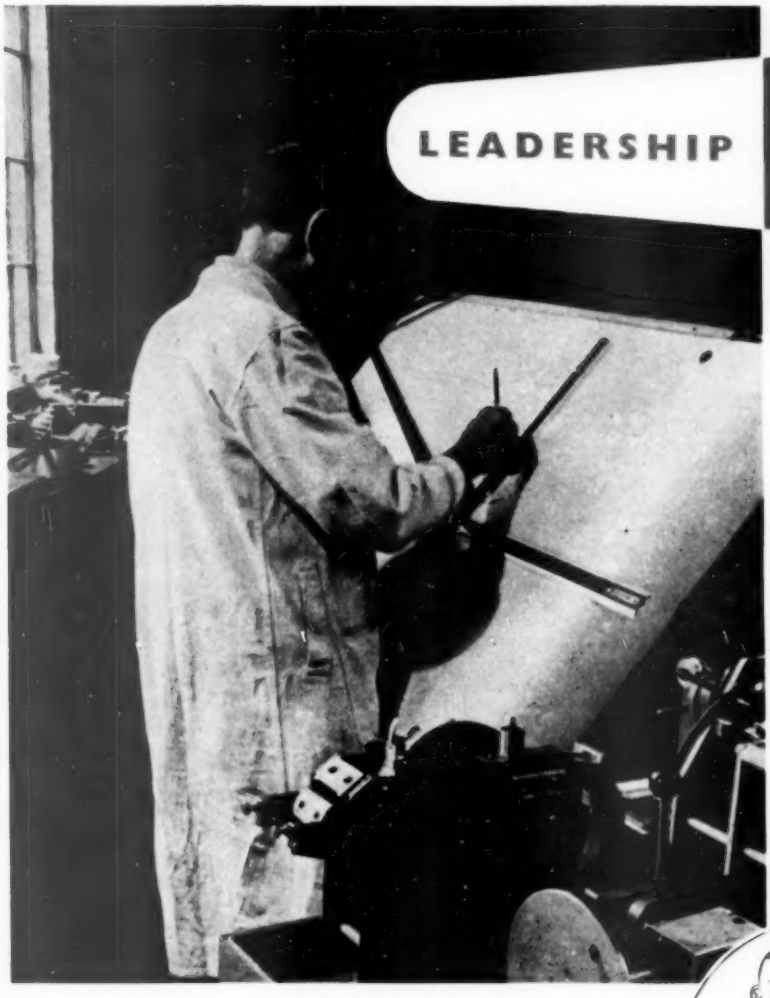


LEADERSHIP from the inside

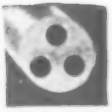
Quest and Test—symbols of Condenser Perfection

Long before any condenser assumes its physical shape on the production line, prototypes will have undergone life and breakdown tests, and — even before that — it will have been laid out on the drawing board. Side by side with this development work, there is a section devoted to the design and construction of the unique machines which have made possible the large scale production and testing of T.C.C. Condensers. Here is leadership — made, and in the making.

TCC

SPECIALISTS IN CONDENSERS SINCE 1906

THE TELEGRAPH CONDENSER CO LTD *RADIO DIVISION* · LONDON · W.3 · Tel: ACORN 0061 (9 lines)



The Finest Cored Solders in the World

FOR RADIO AND ELECTRONIC MANUFACTURERS

ERSIN MULTICORE SOLDER is the only solder containing 3 cores of Ersin Flux, a high-grade rosin which has been subjected to a complex chemical process to increase its fluxing action, whilst still retaining the non-corrosive properties. Ersin Flux makes precision soldering quicker and more economical—it not only prevents oxidation during soldering but actually cleans the surface to be soldered, removing any oxide from the metal.

The correct proportions of flux to solder are always assured—no extra flux is required. Three cores of flux provide thinner solder walls, giving instantaneous melting.

Soldered joints made with Ersin Flux do not corrode even after prolonged exposure to any degree of humidity.

Ersin Multicore Solder is made as standard for factory use in 6 alloys and 9 gauges, and is supplied in nominal 7-lb. reels. Other alloys and gauges can be supplied to special order. Bulk prices on application.

FOR METAL FABRICATION

ARAX MULTICORE SOLDER contains 2 cores of non-rosin Arax Flux ; will solder practically any metal instantly, including blued spring steel. Flux residue is easily removed with water. Supplied as standard in 3 alloys, 9 gauges, on 7-lb. reels for Manufacturers. Available also in Size 8 cartons (5/- subject).

FOR RADIO ENTHUSIASTS & SERVICE ENGINEERS

ERSIN MULTICORE SOLDER is made in 4 specifications for radio and electrical use. The well-known Size One carton is simple to use —the wire is drawn out through a hole in the top and cannot become tangled.

SIZE 1 5/- CARTONS (SUBJECT)

Catalogue Ref. No.	Alloy Tin/Lead	S.W.G.	Approx. Length per Carton
C 14014	60/40	14	13 feet
C 14018	60/40	18	37 feet
C 14013	40/60	13	13 feet
C 14016	40/60	16	26 feet

Special Multicore products for specific uses

NEW PACK FOR TELEVISION ENGINEERS

An economy pack for Service Engineers and Workshops using fair quantities of solder. 1-lb. reel containing approximately 167 feet of 18 s.w.g. 50/50 alloy packed in an attractive yellow and black carton, cat. ref. R.5018. 17/- each (subject).

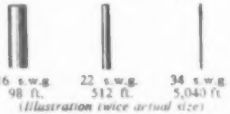
LIQUID FLUXES

For dipping purposes or other processes where it is not convenient to use Ersin and Arax Multicore Solders, the Ersin and Arax Fluxes are now available as liquids. Ersin Liquid Flux is an extra-active non-corrosive flux A.I.D. approved and has been widely used by Electronic Manufacturers in the U.S.A. Bulk price for 1-gallon tins for Manufacturers on application. 10 fl. oz. tins 6/- each (subject).

Prices for Arax Liquid Flux on application.

ULTRA-FINE GAUGES

Ersin Multicore Solder has for many years been supplied on 1-lb. reels to Manufacturers in as fine a gauge as 22 s.w.g. It can now be supplied to special order on ½-lb. reels in even gauges between 24 and 34 s.w.g. Lengths per lb. for 60/40 alloy :—



16 s.w.g. 98 ft. 22 s.w.g. 512 ft. 34 s.w.g. 5,040 ft.

(Illustration twice actual size)

Yes, the 34 s.w.g. does contain 3 cores of flux !

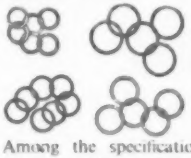
HIGH AND LOW MELTING POINT ERSIN MULTICORE SOLDER

Type P.T. .. Melting Point 232° C.
Type T.L.C. .. Melting Point 145° C.

SOLDER SLUGS AND PELLETS

Where electronic heating methods are being employed, and in other soldering operations, it is often more convenient to use Ersin or Arax Multicore Solder in the form of slugs or pellets. They are available in a wide range of sizes in all standard tin/lead alloys incorporating the time-tested Ersin and Arax fluxes. Where required, they can also be supplied without the flux cores.

SOLDER RINGS



Made from Arax or Ersin Multicore Solder or solid wire. These butt-jointed rings are much more economical to purchase than stamped washers, which can also be supplied.

Among the specifications of Ersin Multicore Solder Rings, which are already being manufactured and for which prompt delivery can be given, are :—

Internal Diameter .. ⅛", ¼", ⅜", ½".

Other sizes to special order.

Manufacturers are invited to write for samples of any of the new lines or to consult our Technical Service Department on any problem in connection with soldering.

Radio enthusiasts and engineers experiencing difficulty in obtaining any of these products should write stating name and address of usual shop.

MULTICORE SOLDERS LIMITED

MULTICORE WORKS, MAYLANDS AVENUE, HEMEL HEMPSTEAD, HERTS. · TELEPHONE: BOXMOOR 3636